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## ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

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AGARD LECTURE SERIES No.160

# Evaluating the Effectiveness of Information Centres and Services

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# NORTH ATLANTIC TREATY ORGANIZATION



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NORTH ATLANTIC TREATY ORGANIZATION  
ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT  
(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

AGARD Lecture Series No.160  
EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES

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## ABSTRACT

### EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES

This Lecture Series presents the current state-of-the-art of evaluating information centres and services both from a theoretical and practical perspective. Case studies are used to demonstrate successful evaluation projects from different countries and to focus on specific evaluation methods and measures. In addition to providing a thorough basis for determining the most appropriate evaluation methods and measures for a given situation and potential problems that can arise in using them, the presentations include discussions of what to do once the evaluation is done. It proposes various strategies for altering the centres and services so that effectiveness is improved; in so doing, it covers political, organizational and practical aspects of evaluation projects so that evaluation is seen from its broader contextual location.

\* \* \*

Ce Cycle de Conférences présente l'état actuel des connaissances dans le domaine de l'évaluation des centres et des services d'information, tant sur le plan théorique que pratique. Des cas pratiques sont examinés, afin d'illustrer un certain nombre de projets d'évaluation qui ont été entrepris avec succès par différents pays, en mettant l'accent sur des méthodes et des actions d'évaluation spécifiques.

Ainsi, les présentations constituent non seulement des bases solides pour la définition des méthodes et des actions d'évaluation les plus appropriées par rapport à une situation donnée et des problèmes susceptibles de se poser lors de leur mise en oeuvre, mais aussi la définition des orientations concernant les mesures à prendre dès l'achèvement de l'évaluation.

Différentes stratégies sont proposées pour la modification des centres et des services dans le sens d'une meilleure efficacité, en soulignant les aspects politiques, d'organisation et pratiques des projets d'évaluation, vu sous l'angle d'un contexte élargi.

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## EVALUATING THE EFFECTIVENESS OF INFORMATION USE

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This paper describes an approach to evaluating the use, usefulness and value of published/recorded information on the work of its users. The reading patterns of professionals and the application of information derived from reading is discussed in detail. Several different indicators of productivity of professionals are developed and correlated with the amount of reading that is done. Finally, several different perspectives on the value of information centres to the professionals they serve are presented.

In the paper "A Framework for Evaluating the Effectiveness of Information Centres and Services," we indicated that information is one of several resources used by professionals to perform their work. In this paper we provide evidence of the extent to which information affects input costs, output performance and productivity of professionals. In subsequent papers we show that information centres contribute substantially to the use, usefulness and value of information used by professionals. Furthermore, the performance of information centres' operations and services determine to a great extent the contribution that is made to the organization served.

Professionals such as scientists, engineers, lawyers, medical practitioners, managers, administrators, and so on, spend about 60 percent of their time communicating. This communication can take the form of interpersonal communication, such as talking or listening to someone, or participation in presentations to groups. It can also involve reading or writing. Typically, about 70 percent of the time spent communicating involves interpersonal exchange of information, and 30 percent reading and writing. The rest of the time of professionals is spent actually performing primary work activities such as thinking, conducting primary or laboratory research, preparing engineering designs or drawings, diagnosing or treating patients, preparing legal strategies, planning and budgeting, and so on.

We find that all professionals, regardless of work role or educational background, spend about the same amount of time communicating; however, the way they communicate varies substantially. For example, scientists typically read and write more than other professionals, and the materials they read tend to be more from scholarly journals and books than from trade journals and non-scholarly books; whereas administrators tend to read much more from trade journals than from any other type of document. Administrators also spend much less time reading than other professionals. For example, administrators average about 100 hours per year reading compared with about 330 for researchers and over 500 hours for lawyers. However, they do spend more time in interpersonal communication.

In order to perform their work, professionals use various resources such as their own time, computing equipment, support staff, advice from consultants or colleagues, and information found in documents. Presumably each resource makes a contribution to a work activity's input cost and output performance. Usually, but not always, better resources cost more but should achieve greater output performance in terms of quantities produced, quality, timeliness, etc. Measuring output performance is difficult, but useful indicators of such performance can be observed. For example, output quantities can be measured in terms of formal records or reports written (e.g. technical reports, lab notes, etc.), written proposals or plans, presentations made (e.g., about research results, proposals or plans, etc.), and so on. Productivity of professionals is the relationship between output performance and input costs (e.g., amount of research recorded divided by scientists' hours spent performing research).

In our studies, we have carefully examined one resource used by professionals: information found in documents. For a range of work activities, we have observed professionals' assessments of the relative importance of information and other resources. We have also established indicators of the effect of information from documents on input costs and output performance (in terms of output quantities, quality and timeliness). Finally, we provide indicators of the effect of information on productivity, in terms of several types of output quantities divided by relevant number of hours of professional time spent producing them.

Input costs associated with information found in documents is measured by the costs of obtaining documents and of actually reading them. We find that the reading costs tend to dominate the costs of obtaining the documents (by a factor of about five to one). Although the amount and type of reading varies among professionals performing different work roles, professionals from all work roles read a great deal and spend substantial time on this reading. For example, the average annual amount of reading and average annual time spent reading per professional in various work roles are observed as follows:

Annual Information	Management	Administration	Operations and Other	R&D	Medical	Legal
Number of Items Read*	260	110	180	240	240	370
Time Spent Reading	230	100	200	330	270	510

Professionals' time is a scarce resource and, therefore, if they choose to spend 100 to 500 hours reading each year (depending on work role), the knowledge gained must be of substantial usefulness and value to them. In fact, we have gathered a great deal of evidence that this is true. In-depth studies in twelve companies or government agencies, provide evidence that information is indeed important and may have an appreciable effect on professionals' work.

The principal purposes for which reading is done are to accomplish the professionals' primary work such as research and development, management, administration, and so on. For example, about 60 percent of the reading of journal articles is for the purpose of accomplishing these primary work activities. Some reading (5%) is done for advising others, making presentations or educating others; some reading (5%) is for writing reports, proposals or plans, and publications. About 30 percent of the reading of journal articles is for professional development. These purposes of reading vary substantially depending on work roles of professionals. For example, only about one-fifth of the journal reading for research and development professionals is for professional development; whereas, nearly one-half of the journal reading of administrators is for this purpose. Administrators are much more likely than other professionals to read journals for the purpose of consulting or giving substantive advice to others.

Professionals employ a number of resources in doing their work. Such resources include computers, terminals, and other equipment (such as laboratory instrumentation); information found in documents; substantive advice from colleagues or consultants; support staff, such as secretaries, technicians, etc.; and information staff, such as librarians, information specialists, etc. Obviously, the most important resource of all is the time and effort of professionals themselves. The relative importance of the remaining resources varies among professionals and the work activities for which the resources are employed. For example, instrumentation is the most important resource to engineers in doing primary research; but this resource is of little use to administrators because they rarely perform the activity. Information found in documents is found to be important to all types of work activities and it is the most important resource for such activities as background research and other non-primary R&D activities; writing proposals or plans, reports and formal publications; educating and training others; consulting and advising others; and professional development.

We also established several indicators of the beneficial consequences of reading books, journals and technical reports. One of the most significant consequences of reading these materials is that considerable dollar savings are achieved by avoiding having to do certain work at all, modifying the work or stopping an unproductive line of work. Again, the proportion of readings which result in such savings and the estimated amount of such savings vary substantially among professionals and their work roles. These consequences also vary by the types of materials read. However, such savings across all professionals and all reading in an organization amount to a dollar value that is approximately ten times that of the cost of identifying, accessing and actually reading the documents. Thus, the return on investment in information found in documents is ten to one (using this criterion)\*\*.

For their most recent readings of journals, books and technical reports we asked professionals to indicate the effect of the information read on quality and timeliness of the work activity for which the information was read. We found that a large proportion of readings affect the quality of the primary activity for which the reading was done (44% of journal, 61% of book and 65% of report readings). Similarly, reading was also said to improve the timeliness of the activity, but not for nearly as many readings as for improved quality. Timeliness improvements were said to occur for 19 percent of journal readings, 24 percent of book readings and 22 percent of report readings. Clearly, these results are merely indicators or evidence of the extent to which information affects the output performance of professionals; nevertheless, all such indicators have demonstrated the use, usefulness and value of information found in documents.\*\*\*

\* Reading is defined as going beyond the contents page, title page and abstract to the body of the document. Type of items read include journal articles (trade and scholarly), books, reports, patents, etc.

\*\* We have observed this relative return on information on three national surveys of scientists and engineers as well as twelve in-depth studies performed in companies and government agencies.

\*\*\* Other benefits of reading that were frequently cited by professionals include reinforcing hypotheses or confidence in work, initiated new ideas for work, helped guide future work, broadened or narrowed options concerning work, provided needed intelligence about competitors and provided information for lectures, seminars, etc.

One important indicator of the value of information found in documents involves effect of reading on productivity of professionals. Productivity can be measured in terms of such output quantities as number of formal records (of research, management, etc.) written, number of formal publications written, number of proposals or research plans prepared, number of formal oral presentations made, and number of times in which professionals are consulted or in which they give substantive advice. In all instances, productivity was found to be statistically correlated with amount of reading of professionals. For example, one indicator of productivity is the number of formal records of research and technical work, divided by time actually spent doing primary and secondary research (and development) and in preparing such records. For 252 professionals we observed the following relationship between amount of reading and level of productivity\*.

		Productivity		
		Low	High	Total
Amount of Reading	High	50	77	127
	Low	84	41	125
	Total	134	118	252

It seems clear that professionals who read a great deal are more likely to also have high productivity (77 of 127) and, conversely, those who do not read much are less likely to have high productivity (41 of 125)\*\*. We emphasize, however, that we do not know for sure whether high productivity is directly attributable to frequent reading. We only know that those who read more (or less) tend to have higher (or lower) productivity and that the observed relationship is unlikely to have happened by chance. We observed similar relationships of amount of reading and productivity for four other indicators of productivity.

Finally, we looked at several indicators of the contribution that professionals make to their organizations to determine whether those who make greatest contributions read more or less than others. One indicator of contribution is salary. Presumably, those who contribute more make a larger salary. When we pair professionals within work role, degrees and field, and years of experience, we find that those who read more are paid more on the average. In some companies we were given the names of professionals who had received achievement awards, technical awards, patent recognition, and so on. Another measure of achievement is whether a professional is asked to serve on a project or problem-solving team or special committees. In both instances (i.e., award winners and those chosen to serve on special teams) the recognized achievers read significantly more than others. Such findings are not new. Similar evidence was presented by Lufkin who found in a study of engineers "that the people who have been singled out for excellence, whether by promotion, or by publication, or by special recognition for creativity, all read a great deal more than the average".

We feel that there is abundant evidence or indicators that information from documents contribute significantly to professionals' work, thereby giving heavy readers an information edge. Such information:

- o is used for important work activities;
- o has substantial value (or professionals would not devote their scarce time reading);
- o is said to be an important resource for most work activities and it is the most important resource (compared to other resources) for several work activities;
- o results in large dollar savings in staff time and equipment;
- o results in higher quality and more timely work; and
- o amount of reading is correlated with productivity measured in several ways.

This evidence quantifies the information advantage that can be gained by professionals through reading. Below we discuss how information centres increase this information advantage.

\* Note that the level of high (and low) productivity and high (and low) amount of reading varies among organizations.

\*\* A statistical test (Chi-square) rejects the hypothesis (at  $\alpha = 0.01$ ) that productivity and reading are independent (i.e., no relationship exists).

### THE VALUE OF INFORMATION CENTRES

There are three levels that are considered in assessing the contribution that information centres make to the value of information. Centres are not inexpensive to operate. We find from national surveys that companies and government agencies typically spend from \$500 to \$1,500 per professional (user or not) on information centres. On behalf of the organization, the centres buy journals, books and other materials. Acquiring, processing, maintaining and distributing these materials in a timely way is very labor-intensive. Furthermore, they provide a range of other services such as reference, online searching, translation, and so on. In the eyes of management, there must be a clear demonstration of favourable return on this investment.

The first question that comes to mind is whether the price paid for information materials has a concomitant value. One obvious way of assessing this value is from the perspective of the readers. What are they willing to pay for this information? We can readily measure what they do pay, recognizing that they might pay more if they had to. Time of professionals is a scarce resource. Professionals must decide how to utilize their time in order to be most productive. Engineers, scientists, lawyers, administrators, and so on, devote a substantial amount of their time to accessing, reading and using information found in documents, such as journals, books, technical reports, patents, and so on. Their decisions to use their scarce time for information seeking and reading are a strong indication of the value they place on this information. The total time (and the dollar amount represented by this time) that is spent on information provided by information centres is an indicator of value of the information. A large number of studies show this value to be on the order of four to five times that of the cost to information centres of purchasing and providing these materials. That is, even though an organization may pay from about \$500 to \$1,500 per professional for services, the professionals demonstrate that information provided by information centres has a value of about \$5,000. Thus, the centres clearly are providing important information and services.

Of course, the information could be obtained by the professionals from other sources. They could subscribe to the journals or purchase the books and technical reports that are now provided by information centres. Then organizations would lose potential savings achieved by sharing the infrequently read materials, and professionals would not receive information and services in a timely manner. They could use sources outside of their organizations, such as academic libraries, but that could involve substantial professional time required to identify, locate and gain access to materials found in these other locations. They could order materials from document delivery services, publishers or other sources, but that assumes an ability to identify needed information and then locate where it is and acquire it. Furthermore, if all company professionals relied on academic, public or other libraries, these libraries would soon stop making their collections available because of the cost and possible denial of access to their own primary users. In fact, this trend has already begun (e.g., at Princeton University). The point is that having a nearby information centre within organizations saves professionals considerable time and money. In fact, we estimate these savings to be about \$4,800 per professional per year. Generally, we estimate these savings to be of the order of eight times the cost to provide these materials through an in-house information centre. Thus, the return on information for information centres is about eight to one when viewed in this way.

About two-thirds of the cost avoidance achieved by the information centres involves professional time. We have observed, over the years, that professionals tend to spend a relatively constant proportion of their time in information seeking and reading. The time may shift from accessing to reading or vice versa, but the total seems not to vary significantly. With this in mind, we developed a rationale for determining what would happen if professionals had to rely entirely on sources other than information centres. If professionals did not have such a source of information, one could safely assume that they would read less because some of their time would shift from reading to identifying, locating and acquiring information from alternative sources. (Note that not all the time would shift to information seeking activities; some would be used for other work-related activities). Therefore, benefits would not be derived from the lost readings. Such lost benefits include savings (in time, equipment, etc.) derived from information and improvements in quality of work, timeliness of work output, and so on. Such lost benefits are what we consider to be the highest order of value of information centre services. This value, compared with the cost of information centres is substantial. The lost benefits alone are found to be of the order of ten to 15 times the cost of providing the services. This we consider to be the ultimate return on information for information centres.

In summary, the value of information centre services can be assessed from three perspectives: what users are willing to pay (in terms of their time and effort) for information provided by the centre, how much more it would cost them to use alternative sources for obtaining the information, and what benefits (or research cost avoidance) would be lost if the centre did not exist. Rough estimates of the average value derived per professional for these three perspectives are given below.

<u>Value Perspective</u>	<u>Value</u>	<u>Return on Information</u>
Willingness to Pay	\$ 5,180	8.6 to 1
Additional Cost to Use Alternative Sources	\$ 4,760	7.9 to 1
Lost Benefits	\$27,000	45 to 1

Similar results have been reported by others as well.

Regardless of how one looks at it, a well run library and professionals who know how to use it can save companies and government agencies an enormous amount of money. Also, productivity of professionals, quality of their work and company profits or return on investment in professionals' time are likely to be improved.

# MEASURES, METHODS AND MODELS EMPLOYED IN EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES

by

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## SUMMARY

Evaluating the effectiveness of organisations and of the services they offer always depends on assuming some kind of model. The main purpose of modelling is to abstract elements from real-life activities in such a way that these activities can be more readily understood, and so better organised and planned. Models may be used for a variety of purposes; for example, to pinpoint which parts of a system should be sampled to provide an adequate picture of the whole. The drawback of all models is that they reflect only a part of reality, and so can only be used in a limited context. In consequence, models must be explicitly formulated and their limitations understood before any evaluation exercise is attempted.

The model helps decide what performance measures can usefully be made. For example, a qualitative model may not be appropriate for guiding assessment in terms of quantitative performance measures. Both model and measures therefore have to be chosen in the light of the desired outcome from the evaluation. The methodology is, in turn, primarily determined by the model and measures chosen.

This talk will therefore begin by looking at the types of model that can be applied to evaluation. It will then consider what sort of measures might be desirable in different context. Finally, the question of how these items can be brought together in practice will be discussed.

## INTRODUCTION

Assessing how well an information centre or service is running entails three different areas of investigation. The first relates to the acquisition of information by the centre or service, and what constraints or problems are involved in this. The second concerns the centre or service, itself, and how well organised it is to handle its own work. The final area involves the output of information to users and how well their requirements are satisfied. Obviously, all three areas are closely linked: a lack of information at the input end, for example, can lead to dissatisfaction by users at the output end. It is a short step from accepting this to seeing an information centre or service as a system which can be analysed in terms of a suitable model. Hence, establishing the effectiveness of a centre or service typically begins with establishing a representative picture, or model, in terms of which its activities can be studied.

## MODELLING

The word 'model' is used in a number of different ways. For our purpose, it can be defined as meaning broadly a representation of something else, designed as an aid for a specific purpose. At one end of this spectrum of meanings, the representation may be a physical entity. For example, a model aeroplane can be placed in a wind tunnel in order to test the designer's ideas for a full-scale aeroplane. At the other end of the spectrum, the representation may be highly theoretical. The motions of the planets round the Sun are governed by a very complex set of mathematical equations which represent the current model of the solar system. Despite this range of meaning, models have a number of characteristics in common. As the definition emphasises, they are almost always intended to serve a particular purpose, rather than to be of universal application. A model aeroplane only provides information in the wind tunnel on one possible configuration. To test other shapes, new models must be built. Each model carries with it its own background of assumptions and presuppositions. It is not difficult to realise this in the case of model aeroplanes, but the specificity is sometimes less obvious for the type of socio-economic model that has been applied to studies of information transfer. In fact, the latter type of model is often much simpler in appearance than the complex models of science and technology. It can give the generally wrong impression that socio-economic models are straightforward to construct and apply.

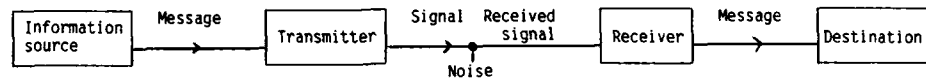
A typical theoretical model might be constructed in the following way.

- (1) The process to be examined is defined.
- (2) The variables which characterise the process are defined.
- (3) The relationships between these variables are defined.
- (4) The parameters (e.g. input/output data) for the process are determined.
- (5) The outcome of using these parameters as boundary conditions for the relationships is determined.
- (6) This outcome is compared with the observed situation.
- (7) An attempt is made to see whether any differences can be explained as due to errors (in the formulation or the parameters).
- (8) If they cannot, a new or modified formulation is tried.
- (9) If they can, the formulation is identified as a successful model, but continues to be evaluated as new data appear.

This detailed description reflects fairly well what happens in the development of a macroscale econometric model. In many studies of information transfer, a much simpler approach is used. In these, the word 'model' is often used simply for a mental picture of the processes which are involved. In

other words, it only implies that steps (1) and (2) in the list have been taken. This can be illustrated by the following example.

Shannon's work on information transfer immediately after the Second World War was basically concerned with the question of how information, mathematically defined, could be transmitted down a telephone line. It was concerned with the quantitative measurement of information flow, and dealt with such entities as bits per event, entropy and redundancy. These were related to the process of one person speaking into a telephone and another person at the other end receiving the message. The simple model for this envisaged by Shannon and Weaver (1) represented a linear message flow of the following type.

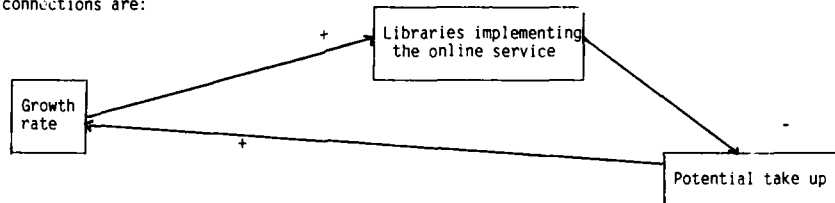


The information transfer approach developed here was a fully fledged scientific model involving all the steps (1) - (9) mentioned above. However, the breadth of its significance was such that it was imported into other subject areas, gradually shedding some of its characteristics as it went. Shannon's original work appeared in the communications engineering literature in 1948. It was referred to in psychology journals in 1949 and, in 1950, appeared in journals devoted to biology, linguistics, physics, physiology and sociology. By 1955, the original work had been cited in at least 17 different subject fields in the natural and social sciences. In the natural sciences, the entire model was of interest, but, in many of the social sciences, interest centred on the flow diagram for information transfer which was often taken over by itself. Most applications of the Shannon-Weaver model today to socio-economic discussions are concerned primarily with a qualitative picture which can act as a simple model to guide thinking. Even if some of the refinements of the original treatment, such as the concept of 'noise', are retained, they are typically treated in a qualitative, rather than a quantitative, way.

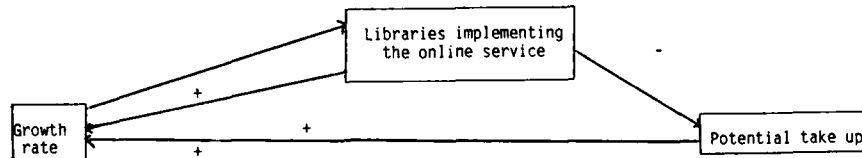
#### EXAMPLE - SYSTEM DYNAMICS

Not all methods applied to socio-economic questions are qualitative. The growth of computer modelling has made it possible to handle quite complex information transfer activities in a quantitative way. An example is provided by system dynamics modelling. This type of model was developed by J. W. Forrester at MIT in the 1960s. It became widely known as a result of its use by the Club of Rome in their 'Limits to growth' study. Such a model sees information activities in terms of an information flow system containing embedded feedback loops. A distinction is drawn between positive and negative feedback loops. The former destabilise the information system, whereas the latter stabilise it. From the computational viewpoint, a system dynamics model is a linked set of differential equations which describe the continuous changes in the system. The system behaviour is described in terms of the rates at which the variables involved change with time and the corresponding variations in their levels. An application of these equations provides an indication of how decisions about the operation of the system will affect levels and rates of change.

To take a specific example, if a new online service is to be introduced, what can be said about the likely rate at which it will be taken up? It could be argued that there is a simple feedback loop here, as shown below. As the number of information centres using the service increases, the number of potential recruits goes down (since only a limited number of centres exists to take up the service). These connections are:



indicated by the + and - signs. But it can be argued alternatively that we have omitted one important consideration. For potential users actually to take up a service, they must obviously know that it exists. The more information centres make use of a service, the more widely it is known; so there is a positive feedback loop, as well as a negative one, and the loop now becomes slightly more complicated.



This simple model can be run on a computer to see how various assumptions about the effectiveness of publicity, resulting from growth, can affect the growth itself.

System dynamics models provide a convenient basis for considering some of the fundamental queries that modelling procedures raise. Firstly, there is an obvious assumption that we are dealing with a closed system. In our example, the loops involve only information centres and the new online service. It is not difficult to think of a great range of other factors that might impinge on the activities represented by the loops, and that have been excluded. Secondly, even within this closed system, a number of implicit assumptions have been made. For example, no allowance has been made for centres which try out the service as an experiment and then drop it. Again, any online service is likely to

begin with a blaze of publicity unrelated to the number of information centres then making use of it. Thirdly, many of the parameters in the system have to be chosen in a fairly arbitrary way. For example, it is not necessarily easy to determine how many information centres are available to absorb the service, or to what extent take-up of the service by one information centre will influence the take-up by another centre. There are two fundamental difficulties here. The first is the level of complexity to which the system should (or, indeed, can) be pushed; the second is limitations of knowledge concerning the parameters involved. These points afflict almost any kind of modelling process.

#### APPLYING MODELS

In practice, models are often used to try out ideas and to see which are the important variables, rather than to derive definitive results. From this viewpoint, modelling can best be regarded as a comparative process, looking at what differences result from introducing different sets of parameters and variables. Socio-economic models are therefore frequently employed as guides to analysis rather than full-blown tools of analysis in their own right. This approach is encouraged by the fact that different people modelling the same system may regard different elements of it as being most significant. For our present purposes, it is probably most useful to look at the types of model that might be employed in assessing an information centre or service, and then to mention briefly applications of some of the more popular approaches.

The most widely used model is based on some kind of flow diagram (as in the Shannon and Weaver model). Such models typically contain nodes linked together by communication channels (in the Shannon and Weaver model, the sender and receiver of a message are the nodes, whilst the telephone line is the channel). Flow diagrams contain four basic elements - the nodes, the channels, the processes involved and the messages. Any of these elements may receive particular emphasis in a given model, depending on the needs of the situation. Both the Shannon and Weaver model and the system dynamics model are organised round the concept of information flows. As this suggests, flow models can be either qualitative or quantitative in approach, though qualitative usages are commoner.

In terms of classifying flow models, the presence or absence of feedback is probably the most important characteristic. For example, the Shannon and Weaver model has been applied to the study of the mass media. In this case, the source might be a speaker on a radio programme whose voice is carried via radio waves (the channel) to listeners in the home. The usual flow diagram here does not involve feedback. A linear model is used in which the speaker influences the listener, but not vice versa. In a telephone conversation, on the contrary, each participant can influence the other; so any model of the process must incorporate a feedback loop. It might be argued that the direct information transfer handled by a centre involved feedback, but some services do not. However, almost any information-handling activity requires the goodwill of its users, and so should include a monitoring element that provides some level of feedback. This monitoring is important not just for gauging user satisfaction. When radio audiences were finally investigated, it was found that acceptance of broadcast information did not follow the model broadcasters, themselves, had supposed. It transpired that some listeners not only received information from the media, but actively disseminated it to friends and neighbours. This secondary dissemination often reached a wider audience than the original broadcast.

Many information centres are involved in providing a service not only for users of information, but also for producers of information (who form part of their user community). In this case, the feedback loop can be so strong that the whole communication process is better portrayed as a single continuous loop. The process of communication can be divided into four phases - the generation of information, its recording, dissemination and utilisation. But, where producers of information are present, the utilisation of information often leads to the generation of new information. So information flow must be modelled as a cyclical process. For example, the production and use of reports can be portrayed in these terms. Typically, a series of stages can be discerned, starting with research and development, then continuing through composition and recording, printing and distribution, acquisition and storage, organisation and control, dissemination and presentation, to assimilation which then leads on to a new stage of research and development. This kind of approach concentrates on the processes operating. An alternative approach concentrates on the communication channels used and their comparative importance. For example, several papers have examined the different paths that information can follow from originator to user, and how this may involve different media.

One point many of these models have in common is that they treat information flow as a sequential process. The information passes through successive stages of handling in much the same way that a car passes along a production line as it is built. This can sometimes be a fair approximation to what happens, but information has a tendency not to build itself up in neat packages. Hence, sequential models of information flow need to be applied with care.

Another point that requires consideration is whether it is better to apply a static or a dynamic model. Although the use of the term 'information flow' presupposes motion, many studies of information transfer assume that it occurs through a relatively static infrastructure. Information diffuses through the unchanging organisational structure in much the same way that water trickles through a sponge. The alternative viewpoint is to suppose that the passage of information is a dynamic activity with the infrastructure adapting itself as it interacts with the transfer of information. The difference between the two viewpoints is especially obvious in studies of communication in organisations. One approach is to take the staff hierarchy laid down by the organisation, and then to observe how information moves vertically and horizontally through this structure. The other is to trace the flow of information through an organisation, determine who are the key receivers and transmitters of information, and examine how they operate. When the two approaches have been tried in tandem, it has usually been found that the information flows only partly follow the formal structure of the organisation. Most organisations have members at all levels in the hierarchy who act as major nodes for information transfer in the organisation. The existence of such 'gatekeepers' illustrates the need to be flexible in the application of models. The choice of model can, itself, partly determine the outcome of an investigation of performance.

The distinction between static and dynamic models can be related to the need to consider whether

information transfer is time-dependent. A snapshot of what is happening at a particular point in time obviously does not entail a discussion of trends. But it is usually necessary to allow for any variation with time in order to generalise the snapshot. For example, communication habits vary throughout the day - direct oral communication over lunch, telephone calls in the morning and afternoon, reading of reports in the evening - so sampling of communication within an organisation must take this into account. In addition, the amount and type of information flow can depend on the channel used. Formal and informal communication, for example, often have to be modelled in different ways.

Conceptual models may have a physical analogue. The flow model, for example, is obviously analogous to the flow of water through a pipe, or of electricity through a wire. Another such analogue that lies at the basis of a number of models is diffusion. When a solid dissolves in a liquid, the amount present at each point in the liquid gradually increases with time. By analogy, information can be thought of as appearing at one point within a system and then diffusing gradually throughout the system. Alternatively, this process of information transfer can be compared with the progress of an epidemic, with each new 'infection' corresponding to someone who has just heard the item of information. These analogies can be expressed in mathematical form and used to provide quantitative results; but they are more often used as qualitative guides to what is happening.

#### MATHEMATICAL ANALYSIS

Most applications of mathematics to information transfer problems involve statistics or probability. A good example is provided by the extensive studies of inter-library loans which subject the collected data to various kinds of statistical handling, including trend analysis. The techniques are often standard in socio-economic modelling; the only point requiring care in information work is that heavy-weight computer methods should not be applied to data that do not warrant them. Such quantitative modelling works very well when cost comparisons are involved. A typical case study might be a cost comparison of online and manual bibliographical information retrieval. Take, for example, a simple exercise of this type carried out by Flynn et al (2). This works by taking time spent on the activities and converting this to money terms. The total time for an online search is the sum of the average time spent per search in search strategy formulation plus the time spent per search at the terminal plus the time spent per search in post search analysis and editing. This can be converted into money terms via the salary of the searcher. To the results must be added the various search charges involved. The final figure can then be compared with the equivalent manual costs. In the specific example given, the total online cost was \$21.50, compared with a total manual cost of \$26.70. This gave for the cost effectiveness of online searching compared with manual searching a figure of 24 per cent. At first sight, this is a straightforward calculation involving no modelling. However, the result actually depends on how the search is carried out and by whom. A search carried out by a senior research scientist has to be costed out in a different way from one performed by an information scientist. Indeed, Flynn et al end their paper by describing a general-purpose cost model.

A related area is trend analysis. This also employs well-tried quantitative methods, but suffers from the usual problem in information work that its scope for application is often limited. It can best be applied to the study of specific activities. More generally, extrapolation of trends can help with certain types of problem. For example, suppose calls on an information service are increasing. To remain effective in terms of response to user demand, it may be necessary to recruit additional staff. But because staff come in discrete units, additional staff may be underworked until demand has grown still further. Hence, the change may enhance the effectiveness of the service, whilst temporarily depressing its degree of economy and efficiency. A proper study of trends can ensure that this effect is reduced to a minimum. But, unless care is taken, this may be putting the cart before the horse. Extrapolation forward basically implies a 'more of the same' approach. At some stage, a manager must decide where the service ought to be going. Analysis of trends can indicate whether it is likely to get there, but not what that goal should be. Hence, the start point is a qualitative mission statement, which can then be translated into quantitative terms.

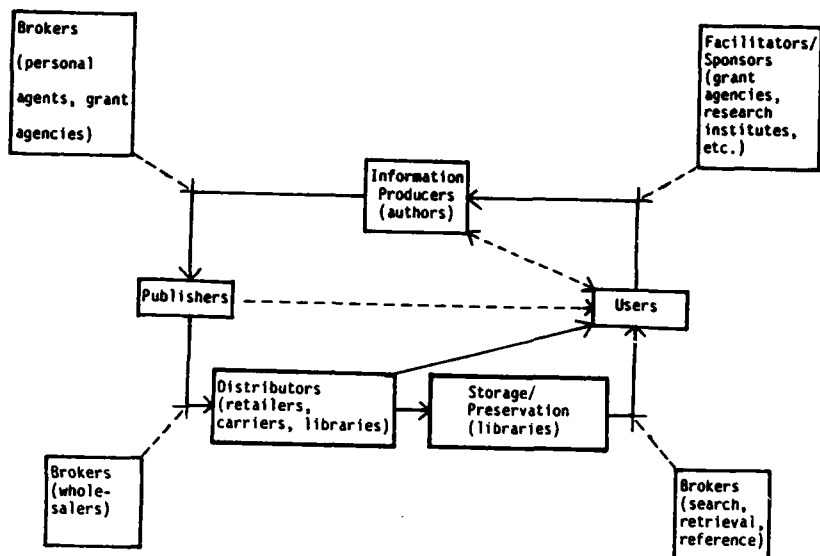
#### FORECASTING

Attempts to forecast the future typically include both qualitative and quantitative data. The balance between the two varies. A service that has been in operation for some years may have accumulated a considerable amount of quantitative data. But if it is a question of starting up a new service from scratch, there may be little in the way of quantitative data to use. As the contingent factors that need to be considered increase, so quantitative methods become more suspect. For forecasts aimed at the immediate future (say, 2-3 years), trend extrapolation is usually safe enough. Longer-term forecasts (say, 5-10 years) run up against the difficulty that the service can no longer be considered as an isolated entity. The environment in which the service operates changes over this period of time, usually in ways too complex for quantitative extrapolation.

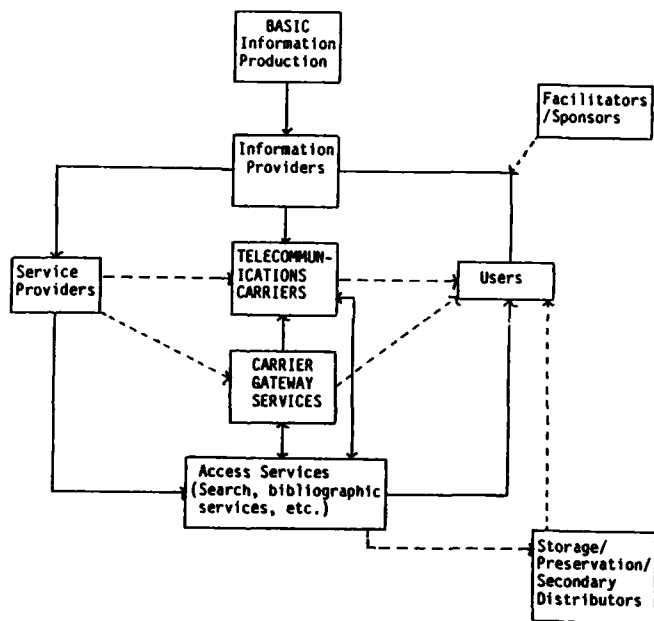
There is a considerable literature on longer-range forecasting, but much of it relates to technology. Indeed, there is often an underlying assumption, explicit or implicit, that new technology will provide much of the drive for future change in the information world. For example, Lesser and Vagionos (3) have put forward the two models shown below for the provision of information services. The first illustrates the traditional flow of information: the second indicates how this is expected to change under the influence of new technology. The changes are based on qualitative extrapolation of present trends - for example, that information will become more easily copied, more easily deliverable and more easily manipulated than at present. On the basis of this qualitative assessment, important changes are forecast for the future: in particular, that information services will become more central to the flow of information than hitherto and that the links in the communication chain will alter.

Technology-driven extrapolations tend to assume that, because technology offers a particular facility, that facility will be used. Though this is often true, there are plenty of counter-examples to show that users will not necessarily take what appears to be the logical path. As with most forward looks, the extrapolation needs to be combined with some assessment of where the total environment is going. One popular method of doing this is via a scenario-writing approach.

Traditional Model of Information Services:  
A Functional Representation



Electronic Technology Based Model of Information Services



'The term "scenario-writing" denotes a technique which attempts to set up a logical sequence of events in order to show how, starting from the present (or any other given) situation, a future state might evolve step by step ... scenario-writing may be regarded as an extension of contextual mapping to the formation of a synoptic view of as many developments as can be grasped and as may appear relevant to an experimental simulation of a possible reality' (4).

The aim of this approach is therefore not to produce a single picture of where things are going, but rather to map out a series of possible pictures of the future and the paths to them. For example, some time ago Aslib looked at the possibility of using a scenario approach to examine the impact on new technology of library and information manpower in the U.K. (5). Three scenarios were chosen. The first supposed that future changes would follow current trends, so the future impact of technology on manpower could be extrapolated directly from what is happening now. The second postulated that a change in services would take place. Developments would go ahead as in the first scenario, but resultant job losses would be offset by the establishment of new types of services. The third scenario postulated the opposite effect. New automated services would appear, but they would act to displace manpower at an even more rapid rate.

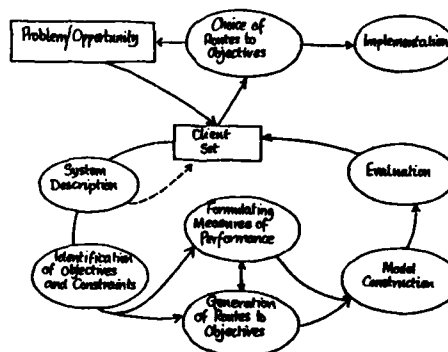
This example demonstrates the basic properties of scenario-writing. They are designed to bracket the likely future possibilities, and they allow room for a range of factors to be included along with technology. In consequence, examining a scenario gives a feel for the whole range of factors involved. Perhaps more importantly, it allows a comparison between possible trends and desired objectives, and so indicates the factors which may hinder, or facilitate, reaching these objectives. A full scenario-writing study can be very time-consuming, but, as with most approaches to modelling, elements of the method can be used for a more rapid and superficial evaluation. The approach does emphasize the importance of considering both qualitative and quantitative factors in making an assessment. This point can be seen even more clearly in the application of a systems approach to modelling information handling in an organisation.

#### THE SYSTEMS APPROACH

A 'system' is a group of related elements organised for a particular purpose. Systems can be physical, biological, social, etc., but the ones of most interest to information work are a combination of the social and technological. Many of the operations carried out by information centres or services can be described as 'systems'. One advantage in doing so is that such an approach can lead naturally to a definition of performance measures for the system concerned. A distinction must be drawn between two methods of tackling systems - the 'hard' and the 'soft'. The hard systems methodology is based on an approach common in engineering, which is especially aimed at the management of change. It reflects the need to structure the sort of messy problems encountered in real life, so that they can be tackled in a logical sequence of steps. These can be listed as follows:

- (1) build up a comprehensive picture of the situation and the issues involved;
- (2) set objectives for the change which accurately reflect the concerns;
- (3) design a range of options or alternative strategies which meet the objectives.
- (4) manage the choice between alternative options;
- (5) development a strategy for implementing the changes.

The model based on this list is shown below: note that it represents not the system itself, but a way in which the system can be examined.



#### SEQUENCE OF STEPS IN THE HARD SYSTEMS APPROACH

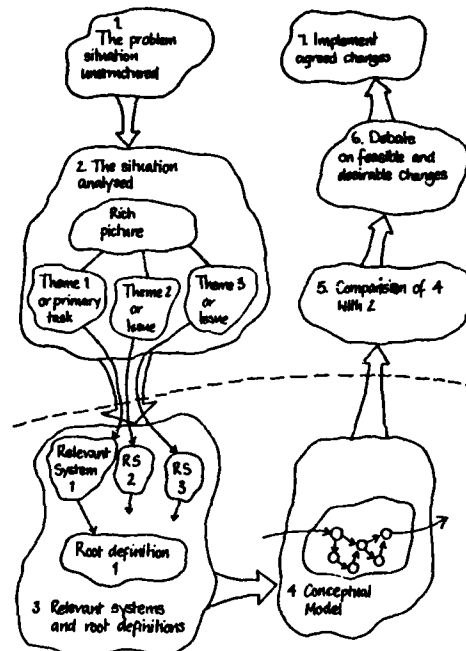
The diagram seems to show a linear progression in tackling the problem. In practice, things are less simple because working on the problem usually brings new insights, and these have to be fed back to earlier steps in the model. So application of the model is generally iterative. In fact, the hard systems methodology is intended for use especially by consultants, who are frequently faced by clients

who alter their minds and so entail alterations to the parameters as the work progresses.

The stages in the process can be summarised as follows:

- (1) **System description.** This sets out what the project is about and what the problem that has been identified is. This leads to problem perception, which lays out who is involved in the project, to what extent, and what their perceptions of the problems are. The next step is to decide what are the basic elements involved in the problem. Some will be describable as systems, but some will be non-systemic. The latter must be separated out, and a decision made on which of the former should be studied in detail.
- (2) **Identification of objectives and constraints.** The former say where you want to get to, and the latter what holds you back. The objectives often include items over which you have some control, whereas the constraints are imposed by the environment and are often beyond control. The objectives must be chosen in such a way as to provide an indication of what action is needed for them to be attained.
- (3) **Formulate measures of performance.** The hard systems approach stresses the need to devise ways of measuring whether objectives are being reached. What measure is appropriate for a particular area of performance, and what target level of performance should be aimed at after what period of time? For example, suppose the objective is to increase the number of users of a commercial online service. The objective might be formulated as a requirement for a 20 per cent increase in the number of subscribers over the next twelve months. There are frequently several different potential ways of attaining a given objective, and the need is to compare them. For this, it obviously helps to have all the performance measures expressed in the same terms. The most popular common quantity is money, but it cannot be applied universally. Speed of delivery of a service, for example, is obviously most sensibly expressed in time terms.
- (4) **Generation of routes.** Objectives can usually be arranged in a hierarchy, with the lower-order objectives contributing to the fulfilment of the higher-order objectives. The important action at this stage is to expand the hierarchy, so that the higher-order objectives can be reached by as many different routes as possible. Then the list can be narrowed down to produce a set of most acceptable routes, given the existing constraints.
- (5) **Model construction.** The formulation of a list of routes is equivalent to setting up a model of the system. According to the hard systems approach, each route should be labelled with a statement of how performance will be measured at each point. If the system being studied is fairly simple, the relationships and numbers in the final model can be worked out by hand. For more complex systems, computer modelling may be needed. It is typically at this stage that the assumptions built into the model are tested. If they are found wanting, it may be necessary to go back to the beginning.
- (6) **Evaluation.** This is partly an extension of the previous stage. It involves a full testing of the model to explore its sensitivity to variations both in the assumptions it is based on and to the parameters which are input to it. But it then leads on to a quantitative comparison of the different routes to the objectives together with an assessment of what are the virtues and defects of each route.
- (7) **Choice of routes.** The clients and the consultants get together at this stage to decide which options should be selected for implementation. In many cases, there is no single 'best' route: each will have advantages and disadvantages. At this point, non-quantitative factors (perhaps of the sort that were discarded at the beginning as non-systemic) may decide which route is to be taken.
- (8) **Implementation.** The decision on which option to take must be based in part on a feeling about what it is feasible to implement in practice. For example, some routes might seem advantageous to management, but be unacceptable to the workforce. This requires decisions as to the strategy to be employed in introducing the recommended changes. Which part of the plan shall be introduced when, and what will the overall implications of the changes be?

This description of a hard systems approach may be contrasted with an equivalent soft systems approach. The latter is concerned with description and qualitative factors, rather than with quantitative measures. It is similar to a hard systems approach, however, in emphasising a step-by-step structured analysis allowing plenty of scope for iteration. The model used in this kind of analysis is shown in the diagram below, and can be described along the lines of the hard systems approach.



STAGES OF THE SOFT SYSTEMS METHODOLOGY. REAL WORLD (top), ABSTRACT WORLD (bottom)

- (1) The problem situation. This forms the initial stage of finding out as much as possible about the problem to be studied, especially by talking to the people concerned.
- (2) The situation analysed. The information so gathered is brought together in order to formulate a picture of what is going on. The word 'picture' is to be taken literally here, for a key element involves drawing a 'rich picture' - a kind of cartoon which brings together all the elements, hard or soft, which appear to be relevant to the problem. The elements may either relate to structure (factors that change only slowly with time, such as the institutional hierarchy or the physical layout of the building which houses the organisation) or to process (factors that change rapidly with time, as many organisational activities do). The rich picture is examined to determine two things. The first is the primary tasks - the tasks which the organisation was created to perform, and those which it must perform in order to keep itself running. The second involves issues. These are the items of concern which form the basis of the problem to be solved.
- (3) Relevant systems. At this stage, the investigation moves from the concrete to the abstract. Each problem that has been isolated in the rich picture is examined to see whether it can be conceptualised as some form of system. If so, it is classified as a 'relevant' system. Several such relevant systems can typically be devised for each problem theme. The essential characteristics of each relevant system are then encapsulated in a 'root definition' (a description in a couple of sentences).
- (4) Conceptual model. This involves deciding what is the minimum set of activities that will fulfill the requirements contained in the root definitions. The list of activities is then put in order, so that each follows in logical order. This exercise usually leads to the drawing of a diagram (representing the model) which traces the logical consequences of following a particular relevant system.
- (5) Comparison. At this point, the abstract model is compared with the original problem situation. There is usually a mismatch between the type and sequence of activities visualised by the model and those that actually occur. Any such occurrences are itemised at this stage.
- (6) Debate. How important are the mismatches between the model and the problem? To what extent can any changes suggested by the model be implemented? One important question is often whether the difficulties are general, so that it would not be feasible to implement the proposed changes under any circumstances, or whether they are peculiar to the specific situation.
- (7) Implementation. As with the hard systems approach, the consultant can advise the clients, but is rarely responsible for the actual process of implementation.

#### PERFORMANCE MEASURES AND INDICATORS

The hard and soft systems have been described in some detail because they highlight a number of the central points in examining the functioning of an information centre of service. Firstly, both approaches emphasise the central role of the model in the evaluation. Secondly, they indicate the limits on what can, and what cannot be measured. Performance measures, as usually defined, are quantitative. A distinction is sometimes drawn between measures and indicators. The former represent a direct assessment of an activity. The latter measure (usually, though not always, quantitatively) some parameter which is believed to be related to the activity. For example, it is difficult to measure staff morale, or even define it in a measurable way. So it might be postulated that absenteeism, which can be easily defined and measured, is an indicator of staff morale.

Three types of activity can be distinguished where measures, or indicators, can be derived.

- (1) Input measures - such as stock acquisition, staff time, overheads.
- (2) Intermediate output measures - such as enquiries answered, searches done, number of users.
- (3) Final output measures - measures of quality, such as the relevance of the information provided, and measures of value, such as the amount of money saved by a user as a consequence of obtaining information from a service.

The comparison of input with intermediate output measures gives an indication of the efficiency of the system, since efficiency concerns the conversion of inputs to outputs with minimum wastage. However, this comparison does not always reflect on the economy of the system, that is whether the information is being provided at the lowest possible cost. A comparison with final output measures gives the effectiveness of the system, since this concerns what clients gain from a particular level of service. It is worth emphasising that there are many variant terms and usages of terms in this field. Thus the distinction drawn previously between 'measures' and 'indicators' is not universally accepted. Some writers use 'efficiency' to cover both efficiency and economy as defined above. Again, the types of measure can be divided in other ways, e.g. into input/processes/output. Hence, reading papers on the measurement of performance requires some attention to the details of definition.

A further point to be noted is that information handling is a trickier item to perform measurements on than most other productive activities. From this viewpoint, some comments by Rice and Blair (6) are worth quoting:

'Information does not itself behave like physical inputs or outputs. Constrained only by the physical markers used to transport its symbolic content, information can be diffused over time and space in ways that material products can never be. On the one hand, its utility may expand the more it is used by more people; on the other, it may lose all worth when other people obtain it. The quality and timeliness of information may be critical to its use; yet quality may be largely subjective and determined separately by the producer and the user. Overabundance may sap the scarce resource of managerial attention. More efficient dissemination of information that is incorrect or unneeded will clearly harm the effectiveness of an organisation. That is, the effectiveness or outcome of many information activities is more crucial than its efficiency.'

#### THE DEVELOPMENT OF PERFORMANCE MEASURES

In view of the particular complexity of performance measurement for information work, it is, perhaps, less surprising that much more has been written, or tried out on an experimental basis, than has been implemented routinely in this area. The current emphasis on the topic can probably be traced back twenty years to a pioneering book by Morse (7). This dealt, from a fairly theoretical viewpoint, with library effectiveness. A few years later, an influential American symposium looked at approaches to measuring library effectiveness (8). One point that emerged was the importance of examining essentially qualitative factors (such as user satisfaction), rather than concentrating on quantitative measures only. There was considerable discussion of what quantitative measurements could be devised which would permit inferences about qualitative factors to be made - the question of performance indicators, as we have defined them. A distinction was drawn between static and dynamic measures. It was felt that librarians were then more concerned with static measures relating to stock, rather than dynamic measures relating to service. By 1972, over 500 articles and books on performance measures for libraries had already been published, but most concentrated on a few basic types of measure - accessibility, cost, user satisfaction, response time, cost/benefit and use. Where applications of these had been made, they seemed to be more often to parts of the system, rather than to the library as a whole. Much of the emphasis in this early work was on the need to measure effectiveness. For example, Orr looked particularly at how the goodness of library services might be measured (9). He decided that the ultimate criteria for evaluating a library service are quality (i.e. how good the service is) and value (i.e. how much good it does). Another characteristic was the continuing emphasis on mathematical sophistication. Rodwell blamed that, in part, for the lack of use of performance measures, along with the cost and time involved and the lack of motivation (10). White backed these comments, noting that the emphasis on theory of performance measures tended to leave out the human element, which is central to much library and information work (11). He also remarked that performance measures were still far more talked about than applied.

Things began to change towards the end of the 1970s. (For an up-to-date survey of these changes, see Goodall (12).) In the U.K., local government had become increasingly interested in performance measures during the decade. In 1979, Putting performance review into practice was published. It set out guidelines for the measurement of local government activities, and included a section on review procedures and output assessment for libraries. The methodology is based on looking at the needs of specific client groups and measuring the extent to which they are being met. In 1980, the American Library Association held a conference on library effectiveness: a state of the art. This contains a paper by Williams which reports on an American survey of public libraries employing 22 different measures to indicate trends and relationships. The paper underlines a point frequently made elsewhere that a

considerable fraction of the data traditionally collected by library and information services are of little value from the viewpoint of compiling performance measures. A clear trend during this period was to explore comparative measures of performance. In the U.K., a feasibility study in 1977, followed by a field trial in 1979, led to the publication of Pilot comparisons for public libraries (13).

More recently, a similar comparison has been made of academic libraries (14). Such comparisons were expected to allow identification of areas of strength and weakness, so encouraging attempts to improve performance. It had already been found for a variety of industrial activities that comparative evaluation provided a good management tool, especially if carried out on an annual basis. The procedure has the virtue that like is being compared to like, and the defect that, if the standard is low in all the institutions surveyed, a comparative evaluation will not reveal the fact. Much of the relevant work on performance measurement has been aimed at standardisation, so that the same procedures can be used by a range of organisations. In 1985, the U.S. Office of Management Studies looked at performance measures for academic and research libraries. The report notes some familiar points: for example, that the more sophisticated methods for deriving performance measures are generally too complicated for ordinary use, and that the definition of objectives by libraries in such a way that their achievement can be readily measured is rare. The Office describes a model for measuring performance which takes into account the kinds of measurement made, user expectations, standards, objectives and evaluation of services. The problem of lack of clearly defined objectives was noted also for public libraries in a British report on A costing system for public libraries (15). This recent report found, however, that all types of library are now taking the application of performance measures more seriously. This was perceived to be in response to the increasing pressures due to (1) their perception of declining resources; (2) a perceived demand for an improved level of service; (3) an increasing demand for accountability. Librarians' interest was found to centre on deriving finance-related data, especially concerning cost centres, functional costing, client group costing, performance indicators and income. The report also notes that several simple methods of measuring performance are now available for application. In addition, the growing use of computer systems in libraries is making it increasingly easy to collect certain types of data which can be employed in constructing performance measures.

This last point is important because it is closely tied to the question - why are performance measures for library and information work so little applied? It is worth quoting a relatively recent publication on cost management for libraries (16).

'The practice of costing library and information operations and the principles and techniques available to support the economic management of library and information services, are one of the weakest areas in the repertoire of library management ... In addition, the actual machinery (consisting of procedures, conventions, systems, forms and specifications) will be found to be relatively underdeveloped compared to the conventional business enterprise, whether it is industrial or commercial, public or private sector.'

The reasons why performance measures and indicators are not used in library and information work prove on investigation to be extensive. They may be summarised as follows:

- (1) Librarians may not be sufficiently motivated to use performance measures. This may be because they have survived happily without them so far, or because they cannot afford the extra effort required in their present straightened circumstances, or because their employers are opposed to the use of such measures.
- (2) The effort may not appear to be worthwhile because changes suggested by the performance measures cannot be executed owing to limited resources.
- (3) The measures may be seen as inadequate or inapplicable, and it may not be clear how they can be used to establish standards. Alternatively, libraries may not know that suitable measures are available.
- (4) It may seem that simple measures only give a misleading picture, whilst complex measures may require too much expenditure of time and money for regular use.
- (5) The results from evaluation of performance measures can work either way. In some cases, they may underline the efficiency of a service; in others, they may suggest the opposite. Librarians may be more worried by the latter possibility than heartened by the former.

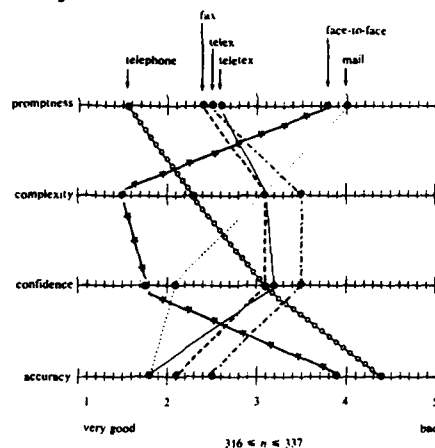
#### MEASURING PERFORMANCE

As the survey of past work illustrates, there has always been a belief that effectiveness is a more important measure in information work than efficiency. The difficulty is that factors relating to effectiveness are difficult to define in quantitative terms and it often requires expenditure of considerable time and energy to collect the necessary data. As an example of the type of problems involved, we may consider a study recently completed at Loughborough (17). This examined the question of measuring the impact of new information technology on the provision of information to users. It is not difficult to formulate a series of questions that need to be answered in this context. For example, one list might be:

- (1) How does the introduction of new communication technologies into an organisation change the existing patterns of organisational communication?
- (2) To what extent do the new office technologies support or subvert the organisational structure as it channels communication flows?
- (3) How will the new technologies affect office productivity?
- (4) Do the new office technologies have greater effects (i) on certain individuals in an organisation than on others; (ii) on certain organisations?

- (5) How does the networking nature of the new office technologies affect their acceptance and use?  
 (6) How can the new office technologies be redesigned so as to become more acceptable and more useful?  
 (7) How important is the name of a new communication technology as a factor in its acceptance?

An examination of this list suggests how many qualitative and, indeed, subjective factors are involved in assessing change. Nevertheless, most can be converted to a form which permits a more objective comparison. For example, a study of office automation in Germany isolated by qualitative methods four factors which seemed especially to affect willingness to use new communication channels (18). These were labelled managerial promptness, semantic complexity, interpersonal confidence and administrative accuracy. An opinion poll of likely users of the new channels led to a weighted assessment of how each channel was seen in terms of these four factors. The resulting diagram makes it easy to compare the properties of new and traditional communication channels, whilst emphasising whichever of the four factors seems most important in a given situation.



Task-Oriented Evaluation of Communication Channels in Organizations

What such studies of the impact of new technology underline is the need to be clear about organisational objectives and how they are achieved. In particular, it is necessary to be clear what the performance measures and indicators are to be used for before trying to select them. Suppose - as is often the case - that they are to be used to look for the benefits of introducing changes into the system. Then, it is obviously necessary to have a full list of possible benefits at the start. The Central Computer and Telecommunications Agency of H.M. Treasury has tried to draw up a list (reproduced below). This contains 40 factors placed in related groups of five. The table reflects very well the spread of measurements that would be necessary in order to do a thorough job of assessing benefits. The Agency divides the factors into three types according to their ease of measurement. These can be paraphrased as being (1) quantitative, (2) qualitative, but related quantitative indicators might be found, and (3) qualitative. Hardly surprisingly, most benefit assessment so far has concentrated on factors in the first column.

POTENTIAL BENEFITS	MOST	LIKELY	INVESTMENT	APPRAISAL	CATEGORY
	Capable of quantification and valuation	Generally quantifiable, difficult to value			Identifiable, but not quantifiable
Freed staff time		x			
Work downgraded		x			
Overtime reduced		x			
Travelling time and cost reduced		x			
Consultancy/agency use reduced		x			
Use of bureau services reduced		x			
Consumables reduced		x			
Less accommodation required		x			
Manning for peaks avoided		x			
Greater accuracy				x	
Tasks eliminated		x			
New tasks taken on		x			
More work taken on		x			
Greater range of information				x	
Greater variety of services				x	
Fewer mistakes				x	

Better forecasts		x	
Better image			x
More reliable information		x	
More creative thinking time			x
Improved turnaround time		x	
Quicker production time		x	
Better quality output		x	
Improved presentation		x	
Lower staff turnover		x	
Better attendance	x		
More job satisfaction			x
More flexible working		x	
More sociable hours	x		
Better tools/facilities/services		x	
Hands-on experience			x
Added value		x	
Smoother peaks/troughs	x		
Better management control		x	
Wider spans of control	x		
Easier communications		x	
Greater organisational flexibility		x	
Lesson learning		x	
Flexibility of approach to calls for change or new tasks		x	

There is an understandable tendency to overlook some relevant advice offered in the early 1970s (19):

'Step 1: Measure whatever can be easily measured. (That is O.K. as far as it goes.)

Step 2: Disregard that which cannot be measured, or give it an arbitrary quantitative value. (This is misleading, but impressive.)

Step 3: Presume what cannot be measured really is not very important. (This is blindness.)

Step 4: Conclude that what cannot be easily measured really does not exist. (This is suicide.)'

The division of relevant factors according to their ease of measurement is, nevertheless, a useful step in many investigations. A current study at Loughborough has examined the role of an electronic bulletin board in providing a focus for the exchange of information between researchers in the humanities. The bulletin board was set up on JANET (Joint Academic Network), a recently established network connecting British universities. Its operations were controlled by a central co-ordinator, who not only looked after the day-to-day running, but also carried out studies of the way the network was used. A printed newsletter was run in parallel with the bulletin board, so that comparisons could be drawn between the two media. A list of factors we would like to know about was drawn up and divided by type. Some examples are given below.

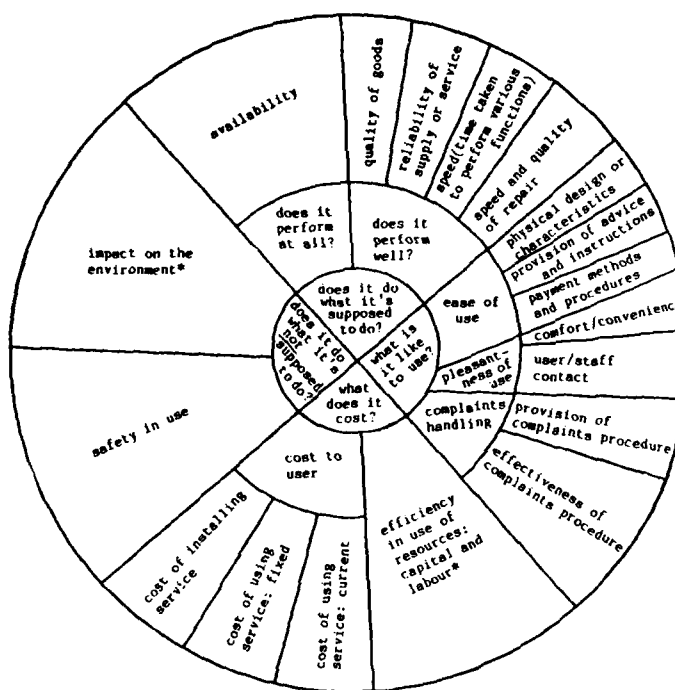
<b>Quantitative</b>	How much information can be transmitted
	Speed with which information can be transmitted
	Cost of transmission
	Reliability of transmission
<b>Qualitative</b>	Timeliness of information
	Relevance of information
	Flexibility of system
	Accessibility of system

The conclusion reached from this study was that a list containing both quantitative and qualitative factors is more easily evaluated by comparing two systems (e.g. printed communication versus bulletin board) than by trying to look at either in isolation. Assessment resolves itself into asking which system is preferable under each heading. After each characteristic has been compared, the final listing makes it relatively easy to see which option is preferable for a given set of objectives.

One problem in obtaining measurements of performance relates to the skills needed to make them. Most factors relating to economy or efficiency lie within the sphere of competence of information centre staff. But effectiveness measures require studies of consumer reaction, and these may entail skills that members of an information centre may not possess. User studies have a deceptively simple look about them, but can be difficult to carry out in such a way as to obtain applicable results. Hence, given the need to emphasise measurements of effectiveness in information work, it may prove necessary either to provide in-house training, or to hire a consultant. An example of the latter approach is provided by a British study of the performance of public libraries, which involved consultancy work by the National Consumer Council (20). The report emphasised yet again the need for clearly defined objectives, but added the valuable point that even library services with clearly defined objectives frequently phrase them in descriptive, rather than prescriptive terms, so making the step to performance measures more difficult. All customers, it is argued, have four basic questions about any service:

- (1) Does a product or service do what it is supposed to do?
- (2) What is it like to use?
- (3) What does it cost?
- (4) Does it do what it is not supposed to do?

The final item is not usually asked - at least in this form - in information work. The general sector diagram, used as a model for directing consumer studies in general, contains an interesting elaboration of these questions (see below). Though some of the factors displayed are less relevant to information work, it is useful to see library effectiveness viewed as just one facet of consumer choice.



This leads to one final point. Performance measurement is linked to the question of purpose: for whom are the measurements being made, and with what intention? For example, data are often needed in order to convince the body responsible for the finance of the centre or service that funding should be continued or even, perhaps, increased. In this case, the need is for performance measures which will convince the funding body of the case being made. Ways of providing such justification might be listed under the following headings (21):

- (1) Show the funder details of how the resources have been spent.
- (2) Show evidence of use of the service.
- (3) Find the cost to a client of the next best alternative to the service, and show that it is greater than the cost of the service.
- (4) Find what clients would be prepared to pay for the service.
- (5) Provide evidence of benefit gained by users of the service.

The first two relate more to intermediate output measures and the last three to final output measures. But, in principle, all five might involve some mix of measures of economy, efficiency and effectiveness. What typically happens is that the provider looks for the simplest mix (in terms of practical measurement) that will convince the funder. Hence, the actual set of performance measures to be implemented in this sort of instance depends on the particular situation and people involved. This may be compared with the continuing collection of standard data for intercomparison between institutions and for long-term trend analysis.

Much work on performance measures and indicators has been aimed at public, national and academic libraries. An obvious reason is because these categories of library form large and important groupings

with some degree of public accountability. Special libraries and information services tend to be much more disparate, and so more likely to set up their own variegated criteria for performance measurement. Hence, more systematised work still remains to be done on information centres and services, but they can certainly learn from all the developments currently under way.

#### PERFORMANCE MEASUREMENT MANUALS

The most useful current development is the production of manuals which provide sufficient instruction to allow the systematic collection of standard data. Two recent manuals are worth considering briefly as examples of this trend.

The first, prepared by Line and published by UNESCO, is intended for international use in measuring the performance of document supply systems (22). There is a detailed discussion of the factors which lead to the selection of the specific performance measures proposed in the manual.

- (1) The fill rate - the proportion of document requests that are fulfilled. This parameter has its limitations, in that many users' needs may never come forward as requests. In addition, what is meant by 'fulfilment' may be ambiguous. A good rate of fulfilment in one subject area may be poor in another. Obtaining the information about the document can also be more than a simple request: it may require an iteration between the information service and the requester of information.
- (2) Speed with which a request is fulfilled. Since fulfilment entails several distinct activities - requesting, processing, supplying - these may need to be examined separately.
- (3) User satisfaction. The most difficult to implement, since it entails questioning the users themselves.

Various measures deemed less significant are also discussed: volume of demand (particularly changes in it), range of resources available (and their relevance to needs), ability to accept blind requests (resources to be extended according to need), robustness and flexibility (ability to expand and adapt to crises), ease of use (affected by the simplicity of procedures), quality, minimal loss and damage, balance and fair distribution of supply, capacity to serve different sectors and ease of monitoring. Line explains why the three chosen measures are basic despite their limitations. He also points out why any such measures can only give a partial picture. Implicitly, if not explicitly, most measures are comparative. So it is usually only possible to say that one service is doing better than another, or that it has improved its own performance over a period of time. Even user surveys tend to be comparative, since the responses depend on user expectations (which may be low, if the service has always been poor). In any case, performance measures can only provide part of the information required in order to implement change. Looking at speed of supply, for example, can be divided into three steps - (1) What is the present speed? (2) Where do delays occur? (3) What are the causes of the delay? The first two steps can be assessed by performance measures; but the third, which is vital in deciding what changes to introduce, is much more difficult to assess in this way.

The discussion of the items involved is finally translated into a set of standard forms for the collection of data on performance. These data can then be turned into the appropriate performance measures. Two levels of assessment are proposed. The first leads to a basic set of performance measures: the amount of work involved should be acceptable even to a small information centre. The second set are more sophisticated and would provide a better overview for larger centres. An example of a proposed form for collecting basic data is shown below. As Line stresses, the important thing is to standardise data collection in this way, so that comparisons can be carried out both externally and internally.

The second recent manual has been prepared by Moore, also with UNESCO funding (23). It is concerned with measuring the performance of public libraries on an international basis. Like Line, Moore proposes there should be two levels of measurement - basic and more sophisticated. The data to be collected and the method of collection are examined in detail under three headings - measures of resource, measures of output and consumer opinion. From the viewpoint of application to information centres and services, the last discussion is particularly useful. At the basic level, questionnaires or interviews can be used to obtain feedback from the relevant community (i.e. all the people who might use the service) or the users (i.e. that part of the community which does use the service). At a more sophisticated level, the suggested methods include unobtrusive testing, where researchers put themselves in the position of users and find how good a service they get; attitude surveys, where people's attitudes to a service (rather than their use of it) is explored; group discussions, where groups of people (typically users) are brought together to discuss the service; depth interviews, where individual's use of, and attitudes towards, information acquisition are examined in detail; checklists, which can be used for a quick study of specific topics. An example of the sort of basic questionnaire that can be used to seek user feedback is reproduced below. Like Line, Moore is especially concerned with the standardisation of data collection. His manual is therefore currently in draft form to allow the incorporation of feedback from attempts in various countries to carry out the recommended measurements.

#### CONCLUSION

How and why measurements of performance should be made has been debated extensively for the past two decades. The most valuable recent development has been the growing trend towards providing standard methods for the collection and analysis of performance data. At present, this appears to be further advanced for national, public and academic libraries, than for special libraries. Individual centres or services which wish to measure their performance systematically can, however, glean a good deal of value from the manuals now being produced. The important stage remains the first - defining what it is wished to achieve in terms that can be measured. Moving from this stage to the actual process of measurement can often be facilitated by introducing a model. So the stages of performance measurement may be summarised as:

- (1) Define objectives (2) Create model (3) Define measurements (4) Make measurements (5) Analyse (6) Implement.

## DOCUMENT SUPPLY SURVEY

Type of library: Use one column for each request

National 1 ☐  
 Academic 2 ☐  
 Public 3 ☐  
 Special 4 ☐

Use only one code for each box

Complete all boxes for each request

	1	2	3	4	5	6	7	8	9	10
Form of material M S OP AV										
Date request despatched (eg 11/2 = 11 February)										
Date item received or request abandoned (use code as above)										
Result F NF A C										
Source N A P S C F										

## NOTE ON CODES

Form of material	Result	Source
M Monograph	F Filled	N National library
S Serial	NF Not filled	A Academic library
OP Other printed	A Abandoned (no response, etc)	P Public library
AV Audiovisual	C Cancelled (by requesting library)	S Special library
		C Commercial supplier
		F Foreign source

Did you come to the library today to look for a particular piece of information?

Yes ☐  
No ☐

If you did then please answer the following questions otherwise go on to Question (insert number of next question)

Did you find the information you were looking for?

Yes ☐  
No ☐

Did you ask the staff for help?

Yes ☐  
No ☐

If you did not find the information you were looking for

Did you ask the staff to find it for you and contact you later?

Yes ☐  
No ☐

Did the staff refer you to another organisation who may be able to help?

Yes ☐  
No ☐

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## European examples of evaluating the effectiveness of Information Centres and Services

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## Summary

There are usually three viewpoints from which an information system, service or product can be evaluated. The first is that of the system or service producers, who will generally be assessing the extent to which their product meets its assigned objectives, and who will be particularly concerned with the improvement of efficiency and effectiveness. Such evaluations do not usually involve comparisons with competing services. The second viewpoint is that of the actual or potential users, whose concern is with the extent to which a system or service meets their perceived needs, and its related cost. This assessment often involves comparisons between services. The third viewpoint, particularly in public-sector operations, is that of the system sponsors, who wish to assess how well a system or service succeeds in meeting policy objectives, some of which may not be explicit.

Quantitative evaluative data are often hard to capture, and difficult to interpret. In some European work, a more subjective approach has been taken, using qualitative information supported by such numerical data as may be gathered, to arrive by a judgmental process at an assessment which takes account of the political factors inevitably affecting any evaluation other than the most basic.

This approach is illustrated by three case histories, of an evaluation of services supplied by a public library authority to local government officials, of the evaluation of the AGRIS service produced by the Food and Agriculture Organisation of the United Nations, and of the evaluative processes applied to proposals for support of database and information service development by the Commission of the European Communities. The aim is to illustrate the application of a basic philosophy of evaluation in three very different contexts.

The title of this presentation might be somewhat misleading, in that it could perhaps be taken to imply that there is a specifically European approach to the evaluation of information systems and services, as opposed, say, to the American school. This is definitely not the impression I wish to give. One might make a case for the existence of an American school, on the grounds that most of the 'founding fathers' of practical evaluation work in our field - Wessel, Lancaster and, most significantly, our Course Director Don King - are American and have done most of their work in the United States, but European workers who have been involved in evaluation work respect, admire and where possible copy the methods used by our American colleagues.

That is to say, there is no divergence in the basic philosophy, or the mental attitude that one brings to an evaluation exercise. Where there are differences in the work done in America and in Europe, they are largely attributable to differences in the individual situations, differences in what is being evaluated, and differences in the reasons for doing the work at all. As far as methodological differences are concerned, it could be said that American work tends to be based much more firmly on the analysis of objective data, or at least what looks like objective data, whereas some European work places more reliance on subjective assessment and individual judgment, supported, wherever possible, by numerical data. The difference in approach is to some extent accidental, but very simplistically one could say that the American approach tends towards the quantitative, and the European towards the qualitative. Of course, personality factors affect the style of work that is done. Evaluations are done by people, and the leader of an evaluation project will inevitably adopt the style of work that he finds most congenial, and this is more related to temperament and early training than to nationality.

I am going to be talking about some studies I have carried out or been involved in myself, and I shall begin by saying something about my own views on evaluation.

Evaluation is generally interpreted as meaning the measurement or estimation of the performance or other characteristics of a service, with a view to determining the extent of its contribution to human activities, its value for money, its performance in relation to other similar services, or the extent to which it has been able, or is likely to achieve some pre-specified goals. Sometimes, as in one of the activities I shall be describing later, the service does not yet exist, but the basic principle, of trying to determine 'worth' in some way, still obtains.

Twenty years ago, when a number of people in the United Kingdom were beginning to be interested in topics like 'efficiency', 'effectiveness', 'cost-benefit' and so on, all concepts that relate to evaluation in some way, there was a great deal of discussion of the meaning of these terms, and it became apparent that everyone

involved in the activity had rather different definitions of these terms. My principal contribution to the discussion was directed towards trying to encourage people, especially people who were going to commission work, to stop using the expression 'evaluation', and to talk instead of 'assessment' or 'appraisal' or some other similar term. This was because a lot of people, particularly administrators, tended to think of 'value' as being, like 'cost', measurable in money terms, so that 'evaluation', meaning 'finding out the value of something', was thought to be a process which would result in the production of some hard, quantitative and highly meaningful measures. This goal is often unattainable in real terms.

Evaluation, that is to say, has a number of related meanings, depending on the reasons for commissioning an evaluation, who commissions it, and why. There is no single, absolute method of evaluation, and any service can be evaluated in a number of ways, from a number of different viewpoints. Some of the criteria used may be subjective, some objective, and some apparently objective criteria are in fact subjective. 'Assessment' is a more general term, which is less of an intellectual strait-jacket for the person charged with carrying out the work, and which conditions the sponsors to expect a less severely quantitative result. Unfortunately, to politicians, who tend to think in extremely simplistic terms, 'assessment' is a less exciting term than 'evaluation', so quite often, appraisals of programmes and services are reported as 'evaluations', even though strictly speaking, they aren't.

Broadly speaking, there are three main groups from whose points of view evaluations may be made. These are, the users or potential users of a system, the managers and operators of a system, and the political or other sponsors of a system.

The user is, in general terms, concerned with getting value for his money. He has an idea of what he wants from an information service, and is concerned with selecting the service or combination of services which most closely approximates to his ideal, at lowest cost to himself in terms of money and effort. User-oriented evaluation often entails comparison of services with each other. Managers and system operators, having decided the characteristics of the service they wish to offer, are most often concerned with the efficiency aspects, meaning the way in which the service product can be achieved with minimum use of resources. The system goals towards which the manager works are usually tactical. System sponsors, on the other hand, are generally concerned with the extent to which strategic goals are achieved. In a private context these goals are related to maximisation of revenue or profit, or market share achieved, and in a public context, to the interrelationship with other policy objectives. For example, production of a guide to environmental information resources is a tactical goal or objective, from the viewpoint of the producers of the guide; from the sponsors' point of view, increasing the level of environmental awareness is a strategic goal, to which the production of the guide is a tactical contribution.

Very often, the user's needs or desires, or the system producer's goals, are not sufficiently explicitly stated as to be able to provide adequate criteria for an evaluation. In such cases, the evaluator has to develop or adapt the criteria to be used, on the basis of discussions with users, managers or sponsors, as appropriate; study of previous policy statements about the service to be evaluated; the published prior art; and his own experience. Some criteria may be appropriate to more than one viewpoint, or to more than one type of system.

I now want to spend a little time discussing some of the criteria that might be appropriate to evaluations from the three viewpoints I have identified.

#### User-oriented criteria.

The user, I have said, is concerned with getting value for money, a vague concept which may mean, among other things, maximising the number of requirements satisfied while minimising the money or effort cost. This is in effect a cost-benefit approach, getting the maximum benefit for the minimum cost. The problem here is usually the defining of the user requirements which are to be satisfied. In general terms, a user is normally considered to want all information relevant to an enquiry (in the case of a query-answering service), or a specific answer to a specific question, or, in the case of current awareness services, all the current information relevant to his job or professional interests. 'All' information may be modified by a time constraint - 'all information since 1980' - or by language - 'all in English or French' - or by some other consideration. In practice, 'all' information is recognised to be virtually unobtainable, and the average user will settle for a subjectively-assessed 'most'. The degree of coverage of a subject by a particular service can be assessed in a variety of ways, in terms for instance of the journal titles covered by the service, or more elaborately by measuring the extent of coverage of exhaustive subject bibliographies.

Currency of response is a factor related to coverage, and the currency of a service, expressed in terms of the time interval between publication of a piece of information and its notification by the service, is measurable reasonably exactly in various ways.

Both coverage and timeliness are strictly applicable only to bibliographic services, or services which provide access to a constantly incrementing information collection. A bibliographic service is covering publications, usually but not exclusively journal articles, which are constantly appearing, and each issue of the service notifies a new time-slice of the stream of publication. Similarly, a numerical database giving information on, say, share prices, exchange rates, or reports from meteorological stations provides a stream of fresh information. A numerical database, such as an index to low-resolution spectra of inorganic compounds, or data on a particular family of organisms, does not increment in the same way, and timeliness has the sense of 'most up-to-date information' in a slightly different way, while coverage ceases to apply, except in the sense of including or not including the members of an essentially finite universe.

Users are also often concerned about the unit amount of information a system can present to them, meaning, in a bibliographic system, the amount of information given about any single item notified. For example, in a titles-based service, is the information sufficient to identify the document referred to, for purposes of acquisition? In an abstracting service, does the abstract allow positive decisions about relevance; does it serve as a document surrogate, or does it merely indicate the broad subject? Some services can give the user a great deal more than he needs to know, and this must be taken into account. For example, if a manufacturer wants regularly to know the names and addresses of suppliers of particular components, he does not need to know a great deal about the financial circumstances or the capitalisation of the suppliers, so subscribing to too elaborate a service is only increasing his costs unproductively.

Ease of access to information, either in broad terms of the user-friendliness of the system or the simplicity of the command language, or in terms of the quality of the indexing, is also important to users. Much of the early effort in evaluation of information services was directed towards the indexing structure, the principal measures used being recall, the ratio between the number of relevant documents retrieved and the number of relevant documents in the system; and precision, the ratio between the number of relevant documents retrieved and the total number of documents retrieved. Recall and precision may be too sophisticated or exotic for a user's own evaluation of services, and can be replaced by a more subjective assessment of general service usability. Recall and precision might be described as confidence factors, because they relate to the confidence a user can have in the system's response to an enquiry. If a system produces no relevant references in response to an enquiry, the user wants to know with what confidence he can then believe that nothing has been published on the subject of his enquiry. I have, incidentally, never seen any tests addressing this particular point.

Cost is an important aspect of service use from the user's viewpoint. Simple cost of service alone is seldom of much value in making a choice between services, and a more meaningful criterion, for a bibliographic service, would be the cost per relevant citation retrieved, or per useful citation. In situations where more than one service is used, it is sometimes necessary to use a cost-per-citation criterion, to take account of the overlap in coverage among services. Cost should include not only the price paid for a service, but also the cost of labour used in its consultation, whether that labour is provided by the user himself or by an intermediary. It does not necessarily follow that a service which comes out well on a cost-per-citation basis is necessarily the 'best' in terms of satisfying a user's needs. It may merely mean that one service has a more attractive pricing algorithm than another, is mounted on a cheaper (possibly subsidised) host, or even, to take the extreme case, has very few useful citations at all but the few there are are very cheap - only one reference in the system, but you can have it for free. Assuming there were a way of quantifying a user's information need, a more reasonable criterion would be related to the unit proportion of that need satisfied per unit cost.

The problem is further complicated in an economic sense by the fact that in practice an individual user's resources for paying for information (either in cash or in labour) are necessarily finite, and frequently small, so that a user choice may often be stated as, 'How much can I get for my money?', or 'How much can I get in half an hour?'. This constraint tends to enforce a qualitative as well as a quantitative approach to system products, the user feeling, for example, 'from this service I don't get many references, but they are all the best ones'. This factor may underlie the success of services based on the contents pages of the best or leading journals, and ignoring all others.

Many evaluations conducted from the user's viewpoint involve measuring the performance of a number of services against a standard set of criteria, then, by attaching weights to the respective criteria, determining which service produces the highest rating. Because of the weights attached to the criteria are specific to individual users or user groups, this is an effective way of choosing a service most likely to find user acceptance. In practice, of course, few users undertake any formal or systematic evaluation in deciding which service or services they intend to use, preferring to operate empirically and on the basis of subjective judgment. As has been pointed out from time to time, users do not necessarily make the best decisions, they make the easiest ones.

#### Managerial criteria.

We may now consider criteria which are appropriate to system evaluation from the viewpoint of designers, managers and operators. It is reasonable, but often unrealistic, to assume that when a system was started, a number of objectives were drawn up, such that the extent to which these objectives have been attained can be used as evaluation criteria. In reality, and particularly in the case of the older abstracting and indexing services, systems are likely to have evolved from humble beginnings, often in an academic environment or from learned or professional society origins, and have only acquired more or less explicit goals at a relatively late stage in their development.

Bibliographic services usually have scope definitions, which define the intended coverage of the service, in terms either of a discipline or a professional grouping, or a range of journals or other definable class of literature. If coverage is defined in terms of specific journal titles, then there is usually no problem in determining the degree of achievement of that particular goal. If, as is far more usual, definition of scope is in terms of a discipline or professional group, it is usually expressed as 'the literature of the subject', rather than 'the literature of interest to workers in the subject'. Whereas a document can usually be defined as being about, for example, chemistry, the literature of interest to chemists can include more or less everything, depending on the professional concerns of the individual chemist, and the literature is therefore substantially less definable, locatable and collectable. Implicit or explicit value judgements often qualify coverage policies, so that trivial or ephemeral literature is excluded, or, conversely, only the research or scholarly literature is included. While the information needs of an individual user can often be relatively firmly defined, the needs of whole communities of users are obviously much harder to specify. Consequently, it is in general easier to evaluate the performance of a service in relation to a specific user than it is to evaluate it in relation to the managerial goals.

Timeliness or currency are important to system managers, as they are to users, more so in the case of services with a large current-awareness component. Services which see their role as primarily or partly archival, or which are intended principally for retrospective search, may give less weight to timeliness. Recall and precision, the tests of effectiveness of the indexing structure, are of concern also, as they are to the user.

Many of the criteria of importance to system operators are managerial in nature, concerned with the clerical or machine processes of compilation of a database, and so are oriented towards cost-effectiveness, whereas user evaluation has more of a cost-benefit style. Quality control aspects, including conformity to agreed standards, error reduction and avoidance of duplicate entries make up much of the managerial concern beyond the cost-effectiveness level.

In considering questions of quality, some consultation and study of the potential or actual users may be implemented, although a service as provided is usually a compromise between the user's notion of an ideal service and the operator's perception of what is technically feasible at an economic price. Included in managerial evaluation are questions related to the possibility of producing the same system outputs at reduced cost, by cheaper input processes, or by automation of some or all activities, by reductions or restructuring of staff, or by other means. The costing aspects of a managerial evaluation are often complicated, in relation to the production of a particular service, by some shared processing with another service; input acquired may be used in producing more than one service, so that the cost of acquisition may have to be treated as an overhead and partitioned among several services, usually on a relatively arbitrary basis.

#### Sponsor criteria.

Lancaster and Climençon (1), in an early paper on evaluating the economic efficiency of document retrieval systems, noted that the interest of the system sponsors (or in their terminology, top management) 'is concerned with a higher level of evaluation, namely assessment of the worth of the system or the economic justification for its existence'. They suggest, rightly, that this is the hardest level at which to conduct an evaluation. I would add that in many cases, the sponsors are concerned not only with the economic justification of the system or service, but also with its political justification. It is simplistic to suppose that straightforward profit-and-loss considerations are all that is taken into account when sponsors decide whether to initiate, continue, change or abandon information systems or services, although of course in some cases, the economic factors are the prime consideration.

In the simple case, and in a purely commercial setting, if a system makes a profit then it is, on the face of it, successful, but even this simple measure of success can be hard to determine. What, for instance, is a 'profit'? Is it an excess of annual revenue over annual running cost, or are the development costs, which are often very high, to be taken into account? In a business context, one is concerned with the return on investment, and therefore it is necessary to consider

the total development and marketing costs as well as operating costs, and to be able to assess at what point the initial investments will be repaid. Even if the full costings look encouraging, so that it is possible to say that a particular service is successful in market terms, and the financial backers are satisfied, this does not give much indication of the value placed on the service by its clients, because there is always the possibility that it is underpriced.

An apparently unprofitable service can be supported even in a commercial environment, for a number of reasons connected with the policy of the producers. An unprofitable online database may be carried by a host because it fits in well with the other databases carried on the system, giving a more rounded 'product mix'. This is similar to the way in which publishers will produce some prestige titles although they know they will not be very profitable, because it enhances the reputation or the image of the publishing house. A service might also be carried because it is a first attempt to enter a new market, and the producer or the host wishes to show some interest or expertise in a particular product area. If any of these considerations obtain, the evaluator must know about them, and be able to say something about the extent to which the service under consideration is meeting these rather nebulous objectives.

When the sponsors are governmental or international bodies, a great many other considerations are likely to apply, many of which will not be very explicit. Obviously, the cost-effectiveness of the system or service will be of almost as much interest as it would be to a commercial sponsor, because public bodies are accountable for the expenditure of public funds. However, as public sector services are often offered at low or no cost to their users, the concept of profit will seldom apply. In some cases, a public sector service may be offered because it is a legal requirement that information should be made available to the public, and it may be necessary to maintain a service even if its use is very small, because of that necessity. In some other cases, the public sector may maintain a service even if no statutory requirement exists, because it considers the service to be necessary in the public interest. Here again, economic factors may not be very important, although it is legitimate for the evaluator to comment on the nature of the public interest which is being served, and the extent to which public interest could be met, by other means.

Some services may be made available because it is considered that the public sector can maintain a more neutral stance vis-a-vis the information offered than would perhaps be the case with a commercial operator. For instance, the European Commission offers services giving guidance on database selection, considering that it can be more objective than any individual host or database provider, because it has no financial stake in the market.

Public sector bodies are as concerned about their public image as are commercial concerns, and in looking at services produced by governmental and international organisations, not only the information-related aspects of service operation should be considered, but also the extent to which the service offered contributes to the visibility of the sponsoring organisation, or serves to demonstrate its interest and concern in a particular area.

There may be many other related goals to consider. For instance, a part of the overall policy of the European Commission is to reduce regional disparities between the Member States. In an information context, this means that in an ideal world, Member States in which the information industry and the information infrastructure are weak should be supported and encouraged to develop themselves to the same level of information activity and ability as the more informationally advanced Member States. One way of doing this might be to support systems which allow the development of expertise and technical capability, or which encourage infrastructural development. Even though such systems may not be profitable in cash terms, or may not be serving very large user communities, the extent to which they contribute to the achievement of the broader political goals may often justify the investment of public funds. The evaluator, therefore, must be aware of these political goals, and must endeavour to measure the system or service impact in relation to them.

#### Common aspects of evaluation at different levels.

There are some features which are common to all levels and types of evaluation. The two most important, which are to some extent inter-related, are objectivity and comprehensibility. They are equally important.

It would be taken for granted that a sound evaluation should be completely objective. This means that not only is the person or team conducting the evaluation free from bias or preconceptions about what is being evaluated, but also the methodology used should as far as possible be such as not to introduce any bias into the results. If a person who is responsible for the operation of a system is also the evaluator, it is possible that the evaluation would be done without bias, but it is not very likely, and what is more important, many people would not believe it to be free from bias. Not only must any evaluation be impartial, it must be seen to be impartial, and this is particularly true whenever political factors have to be taken into account. Visible objectivity is also essential in order to secure the co-operation of the system or service to be evaluated.

No individual is completely impartial about everything, but as far as possible the evaluators should be without vested interest in the operation, the subject matter or the financial support of whatever system or service is being evaluated. In order to guard against possibilities of prejudice or partiality, in situations where everyone may be assumed to be notionally predisposed one way or the other, then it is desirable to have the evaluation carried out by a team so constituted that its various prejudices may cancel each other out. If evaluating an international system, for instance, in order to smooth out political and national differences it would be normal to use a team with representatives from the Western democracies, the Soviet bloc and the Third World.

By comprehensibility, I mean that whoever has commissioned the evaluation should understand what is going to be done in the course of its conduct, and should also be able to understand what the findings mean, and what are their implications for management or policy. This means that at the outset of an evaluation exercise, the aspects to be examined should be discussed with and agreed by those who are paying for the exercise, and if possible by the operators of the system or service to be studied. System goals are often couched in vague or general terms, not sufficiently precise to serve as criteria for evaluation, and these goals need to be made as precise as possible.

The methodology to be used is properly the concern of the evaluator, who, after all, is or should be the expert, but it is useful to explain what is going to be done, and what sort of results can be expected. Particularly in more political settings, it is very important that the broad shape of the final report should be agreed before any work is started. A certain amount of care has to be exercised in discussing the methodology, because everybody with any connections with the information world is an amateur evaluator at heart, and it can sometimes be very difficult to fend off the helpful suggestions and advice that may be offered. It may be necessary sometimes to suffer the support of an advisory committee, but the person actually responsible for the conduct of an evaluation should always make it clear that he or she is in charge. You must have confidence in your own expertise and, while remaining open to genuinely helpful suggestions, never let a committee design your questionnaires for you.

When a study has been carried out, its results and findings will be communicated in a report to those who commissioned the study. Whatever the findings may be, they must be explained in a way which is unambiguously understandable by the recipients. However erudite the methods and measures are that have been used, they must be translated into plain terms, because the object of the exercise is to assist someone to take a decision. It is not the role of the evaluator to take the decision himself, unless recommendations of that kind have been specifically called for, but it is his duty to provide the material to inform decision-making, in such a way that it can be directly used. I think there is often a duty on the evaluator to go a little further than simply presenting the findings. In many cases, those who commission evaluations are not themselves a part of the information world, although it is to be hoped that they have a broad general understanding of it. It is therefore desirable that as well as presenting the findings of an enquiry, some sort of attempt be made to interpret the findings, by giving some discussion as to why the findings are the way they are. One of the things that should come out of a good evaluation is some degree of insight into the way information systems and services work, and the relationship between information and the informed. An evaluator is, in the course of his work, constantly improving and adding to his insights into the information situation, and it is his duty to share those insights. After reading the report on an evaluation, the reader should feel that he knows more not only about the object of direct study, but about the information process as a whole.

It is, of course, essential that the reader can distinguish between conclusions which are supported by the data and observations collected in the course of the study, and those which are supported by no more than the imagination and the experience of the author.

#### Evaluation of a local information service.

Now I want to move to some descriptions of evaluative studies in which I have been involved, to illustrate some of the points I have been making, and to show in some cases how a relatively small amount of hard numerical data is fleshed out by qualitative information and judgment.

The first study I want to describe was carried out in 1980, in the county of Leicestershire in the United Kingdom (2). Leicestershire, like every county in the UK, has a public library system which is funded and administered by the local authority. Speaking from memory, in 1980 the Leicestershire Library Authority budget was of the order of four and a half million pounds, and it operated about seventy-five main and branch libraries within its area. The principal roles of the public library system are given in the Act of Parliament (3) which establishes them as 'to provide a comprehensive and efficient library service for all persons desiring to make use thereof'. This means, in effect, that they lend books and other materials free of charge, and provide reference service, to members of the general public. Many of the public library authorities do much more than this,

and as an example Leicestershire at the time of which I am speaking was providing a specialised service to local government officers and others, comprising a series of current awareness bulletins, a photocopy service, a query-answering service, and document request and delivery facilities.

The current awareness bulletins, which were the principal focus of the evaluation, included five regular bulletins. One, called 'Daily Scan', was a daily survey of the major newspapers, abstracting news and other items appearing in the major national daily papers and the Sunday press, plus the day's Parliamentary activities and relevant radio and television programmes. 'Local Scan' was produced once a week, and provided similar coverage of the local newspapers. 'Scan in parliament' was produced twice a week when Parliament was in session, and abstracted debates in the Lords and Commons, standing committees, and recent official and political publications. 'Scan Review' was a weekly abstracts bulletin covering material relevant to local government drawn from about 800 periodicals. 'Social Work Information Bulletin' was a fortnightly abstracting service of recent periodical literature covering all aspects of social work.

When the study I am describing was first suggested, there were three reasons why the Leicestershire library service felt that an evaluation was necessary. Firstly, the library service itself wanted to be assured that provision of the services was a wise use of its limited resources. Secondly, the library authority felt the need to be able to demonstrate to its masters, the County Council, that the perceived benefits in relation to the work of the recipients of the services justified the costs of providing the services. There was also a desire to be able to assist other library authorities who wished to initiate similar services, by giving them guidance on the levels of cost involved and the perceived benefits that could be expected. After the General Election of May 1979, greater emphasis was placed on containing and reducing the levels of public spending, and this made the first two of these needs very much more acute. The pressures on local authority budgets meant that there was no certainty that the services could be kept in being without change for any length of time, and information about their utility was needed very rapidly, in order to take decisions about their future. This meant that any evaluation mounted had to be carried out as rapidly as possible.

In passing, this sort of situation occurs fairly frequently. In my experience, most evaluations have to be carried out in as short a time as possible, as soon as possible, producing as much information as possible, and on as low a budget as possible. And the harder the problems are, the less is the time available for their solution.

The Scan bulletins, with the exception of the Social Work one, were not designed to serve the needs of a single user group, except in so far as Local Government officers of all departments and disciplines can be said to constitute a group, nor were they intended to meet the full range of their recipients' information needs. Instead, they were designed to provide coverage of potentially relevant information appearing in specific publications, implicitly being intended to save the users the effort of scanning those publications themselves in order to maintain their state of awareness. In these circumstances, rather than adopting a methodology designed to determine whether and to what extent a particular set of notional benefits was realised, it seemed better to take an approach which would indicate what benefits from the use of the bulletins were realised by the user population. Matching service provision against a predetermined set of user needs would have been a more rigorous approach, but it was felt that the more open-ended method would be more likely, given the variety of user groups and the likely variation in their information needs, to provide more insight into the uses and perceived values of the services.

The study was therefore designed in three parts. The first was based on semi-structured interviews with about fifty of the users of the service. The second part involved a very brief questionnaire distributed to the majority of users, and the third was an examination of the costs and effort involved in production of the services. About five hundred copies of each issue of each of the services were printed and distributed (except the Social Work bulletin, of which more than nine hundred copies were distributed), but many copies were seen by more than one person, so the total number of users was somewhat indeterminate.

Interviewees were selected to provide a representative cross-section of departmental staffs within the Local Government structure, together with representatives of the County Council, the City Council, the Leicestershire Constabulary and the Area Health Authority.

The purpose of the interviews was to gather information on the uses of the bulletins; their contribution to professional and general awareness; any deficiencies of the services or difficulties with their format, presentation and coverage; estimates of efforts saved by their use, or replacement effort which would have to be put in if the services became unavailable; and some feelings for the notional value, in cash terms, of the services. An interview schedule was drawn up, with forty-one questions covering the areas mentioned, but this was intended to be no more than an aide-memoire. The interviews took between an hour and an hour and a half each. Interviews opened with a brief statement by the interviewer (myself) about the reasons for the interview, and the funding for the study, to make it clear

that the interviewer was independent of the Leicestershire administration and the library, and that Leicestershire was not paying for the investigation (it was in fact paid for by the British Library). Following this, the general pattern of the interview took the shape of a conversation, in the course of which responses to the points on the interview schedule were obtained, not always in the order in which they appeared there. Because of the conversational style, both interviewer and interviewee felt at ease with each other, and the interviews were generally felt to be agreeable experiences for both participants. This was a little unexpected, but gratifying, and it certainly encouraged a free flow of useful information from the respondents. It should be noted that this can sometimes be dangerous, because the interviewees may be telling you what they think you would like to hear, rather than what they actually feel, but in this case, the professional attitude of the interviewees and the frankness with which they expressed their views encouraged me to think that this was not happening.

The interviews provided a great deal of information, and at the end of the series I felt that I knew much more than before what it was like to be a local government official, what sort of work they did, the different types of information they needed and used, and how they organised their professional lives. This helped to form subjective judgments about the location of the Scan services in the spectrum of their information-acquiring activities, and in effect set the services in context in a way that might not have been possible had a more formal and detached user study methodology been adopted.

Some of the information gained was what I would class as 'quasi-quantitative', in the sense that I was able to count the frequencies with which different responses were given, as would have been the case had I been using a formal survey approach. I use the term 'quasi-quantitative' to draw attention to the dangers of assuming that, because one has been able to produce a number in the course of an evaluative study, the number necessarily means something concrete. For instance, thirty-seven of the people interviewed said that they habitually took professional reading home with them, and four said they occasionally did so. To say that 75.5% of the respondents habitually took professional reading home would be accurate, but not particularly helpful. To extrapolate and say that 75.5% of all local government officers do so would of course be completely unjustified. Using percentages is a device often used by consultants to draw attention away from the fact that they have used very small samples, and often lends a spurious air of precision to essentially imprecise data. The proper conclusion to draw from a finding of this kind is that on the basis of a fairly small but reasonably representative sample, it looks as though about three out of four local government officials in this particular authority take professional reading home with them. (It does not necessarily follow that they then read it, so that point should be explored further).

The issue of value, expressed in money terms, is often central to an evaluation exercise, but it is an extremely difficult area to explore. There are many different approaches. One method is to try to estimate the cost in time and money that would be incurred by the user if he had to achieve the same level of informedness without the aid of the service under study. In the case of the Daily Scan, this would have meant estimating the time that would have had to be spent by the individual users in looking quickly through the daily national press to provide themselves with the same amount of information that was delivered by the service; strictly, to find the same items for themselves that they had identified in the service as being relevant. This cost is then set against the unit cost of the service, plus the cost of time spent using it, and the relationship between the two sets of costings is used to get an estimate of the value of the service to the individual. This is quite a good approach, but it reduces the role of an information service to that of being simply a timesaver. In real life, many information service users would, if the service became unavailable, simply be less well informed. In Leicestershire, if the Daily Scan had been unavailable, virtually none of the users would have attempted to scan the whole range of the daily newspapers for themselves, but would have made do with one national paper and one local. The 'timesaver' approach, that is to say, does not take account of the value of being better informed.

In the Leicestershire study, partly because of reservations about the methodology and partly because of the time constraints, the 'time saved' approach was not used, although what sort of replacement activity would be undertaken if the services were withdrawn was explored in the interviews. To get an idea of the perceived value, I asked the interviewees, 'If this were a commercial service bought in from outside, like a journal or magazine, what sort of price tag would you expect to see it carrying?'. The question was put this way to get an idea of perceived value as reflected by expected cost, and to avoid asking directly 'How much would you pay for it?'. Most of the respondents answered by attempting to calculate a notional cost of production and guessing the circulation, often quite accurately. I then asked them whether they would authorise the purchase of the service from their budgets, at the cost they had estimated. All except five of the interviewees said they would. As you will realise, to dress this up as some sort of hard estimate of value would be unjustified, but at least it showed that most of the respondents did attach some perceived value to the service.

Qualitatively, the interviews produced ample evidence that as a result of receiving the services, the interviewees certainly felt they were better informed than they had been before the services were introduced. Regular patterns of use of the

services had been formed, quite a valuable finding because if use of an information service has been built into the work habits of the users, it is an indication that they consider it to be valuable to them. There were many comments about the style and format of the bulletins, in general reflecting a satisfactory level of confidence in the ability of the producers to select and index the material presented.

One interesting finding, which was not specifically sought, but which indicated a political advantage gained by the library administration in producing the bulletins, was that regular receipt of the service had made many of the recipients more aware of the existence and capabilities of the library service generally, to the extent that a number were making more active use of the library than they had in the past. This could not be classed as a direct benefit to the library, because it had not been one of the goals of the library service in establishing the Scan bulletins, but it could be taken to be a spin-off benefit to the users, in that their general information awareness and specific knowledge of the services available to them had been increased.

The second part of the study was more productive of quantitative information. It consisted of the distribution, with every copy of one issue of each bulletin, of a brief questionnaire. Overall, about 40% of the distributed questionnaires were returned, which is not a bad response for this type of survey, given no follow-up or reminder procedures. There were only four questions, two of which were directed to estimating the number of people who saw the services, or on whose behalf they were used. These questions produced reasonably hard figures, indicating that, for example, the Daily Scan, of which some 500 copies were printed, was seen by about 1300 people and was serving about 3000.

The third question asked respondents to rate the contribution of the service to their job performance, on a scale ranging from 'nil', through 'slight', 'useful', 'very useful', to 'essential'. The question was satisfactorily productive, locating the services in general somewhere between useful and very useful.

The last question called for an estimate, in cash terms, of the value of the service's contribution to the user's work performance, on a six-point scale ranging from nil to over £50 a year. This question worked very well - better in fact than had been expected - and allowed me to estimate, for example, that the value of the contribution of Daily Scan to each recipient was of the order of £15.05 a year. This allowed, by scaling up, the production of estimates for each bulletin of the worth of the total contribution of each to job performance; Daily Scan, for example, came out at £7525 in the best case, assuming respondents to be characteristic of the population as a whole, and £1490 if the respondents were completely unrepresentative. This in turn allowed calculation of cost-benefit ratios by comparison with the figures derived from the study of production cost in the third phase of the study. For the Scan Review, which cost £5335, and produced best and worst case benefits estimated at £8446 and £2065 respectively, the cost-benefit ratios came out at 1.58 in the best case and 0.39 in the worst. (I should note that the costings had actually been done shortly before the evaluation took place, as part of a general audit exercise within the authority, so that there was no need to repeat them for the study). Of course, in presenting these ratios, it was necessary to provide an accompanying interpretation.

This was an interesting study to carry out, because it is very rare to be able to produce more or less genuine cost-benefit ratios at all. In this case it was possible to produce ratios showing the relationship between production cost and perceived benefit for each service, with 'best case', 'worst case' and 'mid-point' estimates of each ratio. Generally, the services proved to be producing value in excess of their cost, except in the case of the Daily Scan service, and for that service it was possible to make some suggestions as to how its cost-benefit ratio could be improved.

Ironically, although both the library authority and the County Council were very satisfied with the results of the evaluation, and generally convinced of the value of the services, a further wave of cost-cutting in local authorities, which required visible cost savings to be made, meant that shortly after conclusion of the study, the services were terminated. External circumstances can always force decisions on administrations or service operators, and evaluators should always be prepared to find that decisions are occasionally taken on a basis of something other than pure reason. This is particularly so in the area of political decision-making.

#### Evaluation of an international service.

The second study I wish to describe is the study of AGRIS, carried out in 1977 at the request of the Food and Agriculture Organisation of the United Nations. The resulting publication is the Report on the Independent Appraisal of AGRIS (4), which shows that you can occasionally win arguments with administrators.

AGRIS came into being as a result of a recommendation to FAO, in 1970, by an international Panel of experts, that a single rapid current awareness service with worldwide coverage of agricultural information should be created, with FAO co-ordinating the activity. After a series of studies, an operational phase was

initiated in January 1975, which resulted in the production of an agricultural current awareness service, producing monthly outputs of ordered bibliographical references to agricultural documentation, in a printed version called AGRINDEX and on magnetic tape. AGRINDEX and the tapes were known as AGRIS Level 1 - there was a notional Level 2, which does not concern us here, and for convenience I shall refer to the system as AGRIS, collectively. It was modelled after the INIS system, the International Nuclear Information System operated by the International Atomic Energy Agency, and the production end, the AGRIS Input Centre, was located in the same building as INIS, in Vienna, using the same machines and production system as INIS. AGRIS input was submitted from designated national input centres, or from regional centres which coordinated the input from several countries. It included both conventional (i.e. journal and monograph) and non-conventional or grey literature.

It was decided at an early stage that there should be an assessment of AGRIS before the end of 1977. It was later agreed that the assessment should be done by an independent body, and UNESCO was requested to organise and administer the study. UNESCO drew up the terms of reference, and decided the composition of the team, which in the event consisted of myself as Team Leader, Professor Lancaster from the Graduate School of Library Science of the University of Illinois, Professor Badran from the Faculty of Agriculture at Alexandria University and Professor Haman, Head of the Agricultural Information Unit of the Polish Academy of Sciences. This was an example of what I have mentioned earlier, setting up a team to represent both developing and developed countries, socialist and capitalist political systems, information specialisation and disciplinary knowledge. If you are lucky, as I was, the team members will reach a quick rapport with and understanding of each other, and will cooperate happily.

The finally-agreed terms of reference are worth quoting at some length, so that you can see the sort of thing you may be in for if you become involved in international studies of this kind. They required consideration of the AGRIS programme in its entirety, and said in part "...past achievements of AGRIS shall be evaluated and recommendations for system improvement or future action formulated, with regard to four criteria:

1. the contribution of AGRIS in assisting development of national capabilities for information transfer (including institutions, services and personnel) and the role of AGRIS in development of international cooperation involving Member States and information systems;
2. the cost of the AGRIS programme in relation to its benefit to Member States, measured in part with respect to criterion 1, with particular emphasis on the viability of the programme, future costs and revenues..
3. the usefulness of AGRIS to the various classes of users of agricultural information both in developed and developing countries;
4. the efficiency of technical aspects of information transfer within AGRIS (e.g. collection, processing and dissemination procedures), of its current and potential products, as well as training and other ancillary services, and of its central management and the interface between this and the participating countries.

These criteria were arranged in descending order of importance, or to put it another way, ascending order of the possibility of doing anything about them. The first criterion was clearly about contribution to broader policy goals, and very much a political objective. The second was a cost-benefit approach, something like a user-oriented study except that because this criterion was concerned with benefit to Member States and not individuals, it also had a strong political flavour. The third was clearly user-oriented in the conventional sense, and the fourth criterion was management-oriented, so this particular study, like most evaluation exercises, had something in it of all the three main types of evaluation of which I spoke earlier.

One complicating factor was that AGRIS had only been in existence for slightly under two years at the time the appraisal was begun, so that it had had little time in which to build up a stable user community, particularly in competition with the services offered by the Commonwealth Agricultural Bureaux and the US National Agricultural Library, both of which were long-established, well-known and heavily used. It had also little time in which to settle into a steady state, with new member states constantly joining the programme, and input procedures constantly changing and improving. Another cause of concern was that the team was to start work at the end of October 1976, and to produce a report by April 1977, which did not allow for a very deliberate approach.

The team first met for two days in Rome in October 1976, during which time we were briefed on the history and development of the AGRIS concept, and given a large collection of documentary material, including consultancy reports, published papers on the subject and samples of the products created. The object was not to have a detailed picture of the scope and operations of AGRIS, but to get a broad-brush portrait of the concept, sufficient to allow us to begin to think. At this stage, we wanted the smell from the kitchen and a picture of the dish, rather than

the recipe.

We felt we could not establish a complete sampling frame for the user population worldwide, because of complications in the ways in which AGRINDEX was distributed in different countries, so we decided at an early stage to run a tracking study to find out who the printed service was actually reaching. We designed a simple questionnaire, in English, French and Spanish, folded round the front cover of AGRINDEX in a very visible way, and addressed 'To the person who is going to keep this copy of AGRINDEX'. The questionnaire asked for information about the distribution route and final destination of the individual copy, who was going to use it, and the purposes of use. We had no great hopes of a high return, but in the event we got back ten per cent of the questionnaires in time for them to be useful in writing the final report, and over a period of three or four years we finally achieved a sixteen per cent return. Given that we did not pay return postage, and given all the uncertainties associated with this approach, this was quite a good response. It did give us some indications of wide penetration of the service, and of actual use by a substantial number of people.

The major part of the study consisted of structured interviews in a large sample of countries, including all the regional centres and all countries using AGRIS tapes. Countries which could not be visited were surveyed by postal questionnaire. Because we felt the impracticability of getting to the ultimate users, we decided that the target population for interview should be the information-processing community, represented by the AGRIS input officers and liaison officers involved at a fairly high level in the provision of agricultural information in their respective countries. We chose the countries for interview to be representative of developed and developing areas, geographically representative, at different levels of support and input provision, and representative of the world's political groupings. We carried out some pilot interviews, in countries where team members happened to be and finally we interviewed in twenty-five countries. The interview schedule used corresponded closely to the questionnaire distributed by post.

This questionnaire was distributed by Professor Lancaster and myself, as we were the team members with most experience of questionnaire design. Its basis came from a long session at the first meeting of the team, when we broke down the aims of the study as set out in the terms of reference into a number of specific points on which it was possible and practicable to gather information. This was a crucial exercise, the hinge on which the whole study turned, and I would like to be able to describe it in detail, but it is not easy to say much about it. We sat around a blackboard and wrote down things like 'What is the national commitment in financial resources, manpower, equipment, etc?' and 'Has AGRIS had any effect on the availability of documents?', and developed question themes from there. The essence of the process was that it was a team brainstorming effort. After this exercise, designing the questionnaire was basically a technician's work. We had to do it in French and Spanish as well as English, these being the official languages of the system, and we had to take great care to avoid any misunderstandings arising from cultural differences among the recipients, any political sensitivities, or any possibility of influencing response by apparent pre-judgment. It was in the end largely a choice-response questionnaire, with encouragement to amplify or explain any answers. It had thirty-five questions altogether, but in spite of the length, respondents did not apparently experience any difficulty in completing it.

After the questionnaire was designed, the team met again in Paris to discuss it, and to get briefing about the countries and persons to be visited for interviews. This was a very valuable meeting; we argued at length over the questionnaire, revised and reordered it and all lost our tempers with it, and eventually reached the point where we shared a common understanding of what the questions were trying to find out. This was what the meeting was designed to achieve, and it achieved it. When more than one individual is going to be doing this sort of interview, a long briefing and discussion stage is absolutely vital.

Then we sent out the questionnaire by post, and achieved a final response rate of twenty-seven per cent, which is not usually considered very good. However, considering the inevitable delays in using the international mails, and the circumstances that in this case the British Post Office sent some of the questionnaires by surface mail rather than air mail, we did not do so badly. Where it was practicable to do so, we also sent interviewees a copy of the questionnaire several days before their interview was due to take place. This is generally desirable, because, particularly when some of the responses are to be numerical or quantitative, it gives the interviewee a time to assemble the required information. Most of the interviews took about three hours, and most were with small groups rather than with individuals. In some cases, it was possible to arrange follow-on interviews with others involved in AGRIS or in agricultural information policy in the countries being visited.

During this activity, we were also collecting information in Rome and Vienna on the details of the processing activity, since this was within our terms of reference. We were given full access to files, correspondence and reports, and in effect collected every sort of number we could relating to the input, throughput and outputs of the AGRIS system.

As soon as we had reached the point where the interviews had been held and we had a number of completed schedules and questionnaires to hand, I put together a first draft of the report. Then the team members met for two days in London and we read the draft, together with other interview material and each others' reports, and then jointly roughed out a list of the major points which had struck us during the work so far. This list had about thirty items on it, and we divided them into two groups, things we felt we had discovered which we called Findings, and things which we felt should be done, which we called Recommendations. This was done in another brain-storming session. I then rewrote the report, prefacing it with the findings and recommendations, and building in the essence of our discussions. This document was then made the discussion paper for the final meeting of the team, with FAO and UNESCO representatives, in Rome.

On the first day in Rome the team again went through the draft report, tightening and polishing it and making sure that what we had said was a consensus view. It was retyped - this was before word processors, and how did we ever manage without them? - and the next day we recycled the whole thing, this time with the FAO representatives, effectively presenting the report in the manner of a consultant to his clients, and accepting or rejecting suggestions as they were made. This is always a very important stage, because no matter how professionally competent the reporting team, the report must be acceptable to the client, in the sense of being immediately comprehensible or practicable, if there is to be any hope of a subsequent result. This is really a negotiation stage, in which the report is made acceptable, but without loss of force or accuracy.

To sum up the AGRIS experience, the stages were as follows:

1. A quick but thorough overview of the problem context.
2. A brainstorming session to set the objectives of the study.
3. A determination of the methods by which information will be sought, and the sources to be approached.
4. Drafting the instruments of enquiry.
5. The collection of information and data.
6. Preparation of a discussion draft report.
7. A Delphi-like iterative process to arrive at the draft final report, and
8. Presentation and negotiation of an agreed final report.

I have said nothing about the findings of the AGRIS study, because the full report has been published by UNESCO, and I am assuming that you will be more interested in the approach to the problems of this kind of assessment than in the detail of individual systems. As to the outcome, AGRIS is still in existence, an established part of the agricultural information scene and more effective than ever before, so you may conclude that the results of this evaluation were positive.

#### Evaluating proposals for database development.

The last exercise I want to discuss, rather more briefly than the foregoing studies, is an activity which has taken place six times in the last few years, and is taking place again in a somewhat different form. Strictly speaking, it is not concerned with evaluation of information systems or centres, because it is about the evaluation processes applied by the Commission of the European Communities to proposals for support of database developments. The Leicestershire study was looking at something that really existed in a fully-developed form. The AGRIS study was looking at something still in a development stage, so had elements in it of trying to guess probable futures. The evaluation of the Calls for Proposals for the Commission is actually almost entirely about evaluation of future possibilities.

From time to time, as a part of its various Action Programmes, DG XIII(B) of the European Commission - the Directorate-General which is concerned with the information industry and information market - has launched Calls for Proposals for the development of advanced information services (meaning, essentially, online or other electronically-carried services) in various fields. Six such Calls have been made, and more than six hundred proposals were received in response. In general, what was offered to successful applicants was 25% of development costs, up to a ceiling of 200,000 ECU, plus a possible additional 25% to cover costs incurred by activities directed towards increasing the European relevance of the proposed services.

Because of limitations on the funds available for support within these Calls, a rigorous selection procedure was necessary, not only to eliminate proposals of poor quality, but to select the best from amongst the good. Criteria had to be developed to identify what was meant, in Commission terms, by 'best', and procedures had to be developed which would not only ensure that the criteria were consistently applied, but which would be demonstrably free from national or other biases and fair to all applicants.

The criteria for selection were always set out in the text of the various Calls, and were decided by DG XIII(B). It was made clear that support would only be given to proposals for publicly-available systems, and that although associated printed products would not be discouraged, the major means of distribution had to be electronic. Proposals had to be able to demonstrate that they were unique in character, either covering areas in which there was no provision, or covering areas in a different way and for a different market than existing provision. They were required to show that there was an existing demand for the proposed service, such that the service, if launched, would be likely to attract extensive use. Proposals also had to satisfy the Commission that they were technically feasible, and that the necessary input information would be available to the proposers.

Proposers were also expected to make a reasonable case that the development presented too high a financial risk for them to be able to justify going ahead without subsidy, but that it would ultimately result in a service that would be financially viable, without continued subsidies. What this meant was that the proposer had to have a good commercial proposition, but avoid giving the impression that he was asking for subsidy simply because the possibility of subsidy existed. There also had to be evidence that the remaining 75% or 50% of necessary funding would be available.

Obviously, because this was a programme on behalf of the European Communities, it was necessary that proposals should be of Community-wide relevance, and should, in the words of one Call, 'have applicability for a whole range of target users, where necessary in several languages, and that the proposed service should be marketed at EEC level, through cooperation with organisations in more than one Member State where appropriate'. The Commission is trying to build a common internal market in information services, by encouraging cooperation between organisations in the Member States, and by breaking down language barriers. The criteria relating to European relevance were politically important, and were rigorously applied.

There were a number of other policy-related criteria. One, perhaps the most important, was concerned with the extent to which a proposed service contributed to strengthening or consolidation of European information supply. The Commission wishes to develop a strong European information industry, able to sell its products and compete successfully in world markets, and capable of reducing European dependence on imported services. This can be done by strengthening the existing organisations which make up the European information industry, and assisting new European organisations to enter the market. A service would increase information flow by bringing new user groups into the marketplace. A third criterion related to the ability of the proposed service to improve the performance of industry, commerce or scholarship within the Community. A fourth concerned the service's ability to contribute to Community exports, both in itself as a service which could be sold on world markets, and by assisting the development of other industrial or commercial products for external sale. The last criterion, also of considerable weight, related to the service's contribution towards diminishing differences in the level of information activity between Member States, which meant in effect that proposals which would be likely to strengthen the information industry in a country in which that industry is at present weak or underdeveloped, or would contribute to strengthening the information infrastructure in such a Member State, would receive favourable consideration, all other criteria being satisfied.

With such a formidable list of criteria, and given the impracticability of constantly going back to the individual proposers to ask for additional information (although we did sometimes seek clarification or more details), the procedure had to ensure that each proposal contained sufficient information to allow judgements to be made, and that the structure of the information should be as standardised as possible to allow comparison between proposals. Proposals were required to be submitted on a standard formsheet, in one of the Community languages and, if possible, in English also, if that was not the language of the original. The formsheet, which eventually ran to 24 pages, asked for details of the proposer, the service or product to be developed, the proposed marketing plan, details of the development plan including costs of activities and staff, source and amount of existing funding, cash flow estimates, forecasts of market penetration, and the responsibilities of any partners in the proposal. The formsheet was intended to be of use to the proposer as well as the evaluators, in organising his thoughts and plans for the service to be developed. Three months were allowed between the launch of a Call and the closing date for proposals.

When the proposals had been received, each was put through a simplified evaluation procedure. This required that a simplified evaluation formsheet was completed by each of at least two evaluators, working independently. One evaluator would usually be a member of the Commission staff, and the other would be an independent expert working under contract to the Commission. The simplified evaluation stage was intended to eliminate proposals which for one reason or another did not conform to the criteria, or could not be taken farther because of lack of detail or clarity, obvious unfeasibility, lack of European applicability or other similar reasons. In the relatively rare case of disagreement between the two simplified evaluations of a proposal, a third evaluation would be made by another evaluator, or the conflict would be resolved by discussion between the evaluators. If a proposal was rejected at this stage, three reasons for rejection had to be given.

Those which passed this stage then went into an extended evaluation. Again, this was based on a standard formsheet to be completed by the evaluators, which was twenty pages long. The first section required the evaluator to spell out exactly what was being proposed, in full detail. The second section covered relationships with existing services, including aspects of competition. The third dealt with the degree of contribution to Community objectives, the fourth covered marketing aspects, the fifth covered the development plan and the sixth dealt with the financial aspects. The last section required the evaluator to recommend support or rejection, together with three good reasons to justify the recommendation. An experienced evaluator would take three to four hours to complete this formsheet for one proposal. Each proposal, as before, was reported on by two independent evaluators, but at this stage the evaluators were free to look at all proposals, annotate each other's comments, add comments of their own or do another evaluation, so that many proposals would carry comments from four or more experts or Commission staff.

During the simplified and extended stages, each proposal was considered separately, in isolation from the others. The next step was that all those which had successfully passed both stages were discussed by the evaluators, and preliminary recommendations made, to ensure that what was being recommended would fit within the available budget. At this stage, proposals were dropped, with reasons for their exclusion recorded. As well as conforming to the criteria of the Call, some regard had to be paid at this stage to the balance of proposed funding between the various Member States and to the possibilities of bringing similar proposals together in a cooperative effort. Finally, for each subject field or group of proposals, evaluation reports were prepared, summarising the main findings, giving the history of the evaluation so far, presenting summary statistics, and listing all the proposals submitted. These summaries were discussed and revised, so that in final form they represented the consensus view of the evaluator.

From this point, the exercise passed from the evaluators to the administrative machinery. A committee of nominated experts from each Member State would be convened, to examine the work of the evaluators, and to make recommendations for action to the next higher committee, which was the Committee of Scientific and Technical Information (CIDST), charged with the oversight of DG XIII(B)'s action plan. The nominated experts were in principal not briefed to consider questions of policy or promote national interests, but were acting as technical experts. Any policy and national inputs were the responsibility of CIDST; CIDST would, after considering the whole exercise, formulate an Opinion, in the shape of a set of recommendations, which would then pass through a Commission selection committee composed of representatives of interested Directorates-General. This committee would then make recommendations to the Director-General of DG XIII, who would take the final decisions on support.

This was a long-drawn-out procedure, but not, considering the complexity, excessively slow. It was usually possible to move from the closing date of a Call to the evaluators' final reports in less than two months, and in the case of the last Call we managed to process over a hundred and fifty proposals in just over a month. It was necessarily a long process, because at all points it was essential to ensure that not only was it as fair and unbiased as possible, it had to be seen to be fair and unbiased. Evaluators from most of the Member States were used, selected by the Commission and not nominated by the Member States; Member States could satisfy themselves about the procedure at both the nominated-experts and the CIDST stages, and CIDST members were free at all times to inspect all the documents, talk to the evaluators and generally monitor progress.

All this was done in strict security conditions, in order to protect the commercial interests of the proposers. It is something of a triumph to be able to say that the integrity and validity of the process have never been disputed.

Why I have chosen to talk about this last exercise, which is not about the evaluation of existing centres or services, but is really a complicated evaluation of possible futures, is because it is a good example of a fairly rigorous procedure based almost entirely on informed subjective judgements. All three of the studies I have discussed had, as you can see, very strong judgmental aspects, and were indeed more reliant on them than on quantitative measures. All three also required an awareness of political factors, which to an extent dictated the approach. What I have tried to show is that subjective approaches and personal judgments can be relied on, and can produce successful outcomes, if the exercise is so structured as to minimise the risks of dependence on individual opinion. Virtually no evaluation can ever depend on objective data alone, and there will always be a need to apply a balanced, disinterested judgment, with due regard to the underlying policy implications.

To end on a slightly lighter note, if you are suffering from a lack of numerical data, you have to present your findings with extra conviction. The important thing, at the end of the day, is to have the client believe you.

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## EVALUATING THE PERFORMANCE OF INFORMATION CENTRE STAFF

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This paper uses the framework for evaluation described in "A Framework for Evaluating the Effectiveness of Information Centres and Services" for evaluating staff performance. Information Centre staff are a major resource affecting the overall performance and effectiveness of services provided. Various measures of staff performance are discussed (including quantities, quality and timeliness of staff outputs), and the relationship between staff performance and the effectiveness of services (from a user perspective) is demonstrated. Finally, alternative methods for measuring staff performance are described.

New technology, changes in user information seeking needs, requirements and behavior, and multiple information formats all have had a profound effect on information centre operations and patterns of use that will, in turn, have an impact on staffing in terms of numbers and types of staff required. Traditional methods of determining information centre budgets, including personnel requirements, have been based on the numbers of constituents served by the centres. The number of professionals employed in information centres per 10,000 constituents has remained almost constant over the years. Unfortunately, such staffing levels do not reflect the realities of the information age.

Information centres must provide access to an accumulating body of recorded knowledge. Since 1970 the amount of knowledge recorded throughout the history of mankind up to that time has more than doubled. One of the unique roles of information centres is to provide access to all of the published literature. Naturally, they cannot each hold all of the literature ever published, but they do provide access to it through other means. Thus, not only do information centre staff have to cope with an ever-increasing amount of new literature, they currently have to provide access to twice as large a body of literature in 1988 as they did in 1970.

Access to this ever-expanding body of literature is provided through an increasing number of databases and database services. These systems and services are continually being enhanced and upgraded and place an increasing burden on information centre staffs, in terms of their need to keep up-to-date with all changes so that they can continue to use the systems and services efficiently and effectively.

At one time, libraries were concerned largely with books, then serials and periodicals; but now they must also store and otherwise provide access to government and technical reports and, because of new technology, audiovisual materials, equipment and software.

The recent growth in the availability of information and "publications" in non-book formats raises several issues for information centres and their staffs. In order to access information captured in various non-print forms users need access to the equipment that is required to "uncapture" it. For example, a videocassette is not readable without a videocassette recorder and a television monitor; a microfiche cannot be read directly without a microfiche reader, and so on. While such equipment may be available in the home or workplace, equipment must also be made available for use in the information centre so that users can review materials before borrowing them; and those who do not otherwise have access to such equipment still are able to access the information. This issue will become more critical in the future as increasing volumes of information products are available only in non-print form.

An issue related to the one above is the need for information professional and user education and training in the use of the equipment needed to access non-print information. Such education and training will be necessary on a continuous basis, particularly if use is relatively infrequent. If education and training are not provided, certain groups of potential users will be cut off from a body of recorded information.

Information centre users are becoming more information intensive. They are increasingly exposed to new information technology -- microcomputers, videocassette recorders, etc. There has been a great deal of discussion, in the literature, of how as the user becomes more "computer and information literate", information centre staff will no longer have a role to play as intermediary. In fact, at King Research we have observed the opposite. Admittedly, end users of information do tend to perform some of their own information searches, particularly when they have become comfortable with available systems. However, as they do more searching they recognize that more of their time is being taken up with information searching and retrieval activities. They learn that there are numerous sources of information to choose from, and that the sources change over time, in terms of coverage, procedures for use, etc. Once they recognize the complexity of information searching and retrieval, they begin to return to the intermediary. However, their experience has given them a better awareness and

understanding of information systems, they are more able to communicate their needs, and they are more sophisticated in terms of their demands and expectations.

One way to discuss the complexities of information centre systems and services and their relationship to staffing patterns is through the conceptual framework discussed below.

Each function will have a set of services and products associated with it, the users of which may be information centre users or staff. The functions, services and products can be divided into activities that are necessary to perform and produce the functions, services and products. Each activity can be described in terms of the resources necessary to support its performance. Resources include personnel, equipment, information sources and services, facilities, supplies, communications, etc. Finally, each of the resource components can be described in terms of its characteristics. Personnel characteristics include the type of personnel (professional, paraprofessional, clerical, etc.), the competencies of personnel (knowledge, skills, attitudes), the level of education of personnel, the experience of personnel, the salaries of personnel, and so on.

Performance can be measured at any of the levels in this framework, but the focus of this paper is performance at the activity level and above. Performance of staff includes productivity, quality and timeliness of performing these activities. The effectiveness of their work is how performance affects user satisfaction, repeated use and the purposes for which information centres are used.

Performance cannot be measured in isolation. A number of factors influence the performance of information centre staff. One factor is the demand placed on staff by users. As the demand increases, so does the workload of the staff either directly (e.g., through increased reference requests) or indirectly (e.g., through increased demand for more materials which increases selection, acquisitions, indexing, and other processing activities; or through increased administrative activities). Thus, one particular aspect of staffing that can be studied is the relationship between current and required workloads and staffing needs. Other factors that affect performance relate to the characteristics of resources. For example, the more competent a staff member is to perform a specific activity or set of activities, the better the performance expected. Similarly, various characteristics of equipment used, information sources and services, facilities, etc. can affect performance levels significantly.

Other factors that affect staff performance (in addition to amount or level of input resources) include management policies and requirements, organizational structure, attitudes or capabilities of users, etc. Factors that influence effectiveness (in addition to output performance) include user awareness, attitudes towards or perceptions of a service, charges for services, distance from service access points, etc.

Data collection for staff performance evaluation is done to help ensure that sufficient levels of performance are achieved. In order to do this we suggest that several measures be observed including: productivity, timeliness of services and quality of some activities and services. There are essentially six methods that can be employed in rating staff performance as follows:

- 1) Observation of Productivity. Productivity can be measured by the number of items produced per work hour. Output quantities may be observed by logs or other means over a specified period of time (e.g., one month or quarter) and corresponding input hours observed by logs, diaries, random observations, etc.
- 2) 100% Inspection or Observation of the Timeliness with Which Activities Are Performed or Services Provided. Timeliness is determined by recording when events take place. Standards for the timeliness of an activity are based on a proportion of events that are to be accomplished within a specified period of time. Acceptable performance might be that no events be accomplished beyond a specified time or fewer than 3 percent accomplished beyond that specified time. All events 100% will be observed to make sure that acceptable levels of standards of timeliness are achieved.
- 3) Random Sampling of Output. In most instances individual observations of performance are difficult or expensive. In these instances, the output is sampled and inspected for timeliness or quality.
- 4) Random Spot Checks. Spot checks ascertain that some activities are being performed as specified. For example, the circulation/issue desk might be observed at random times to insure that it is manned, large queues have not formed, and users are being served properly, etc. A spot check performed weekly or monthly can verify that this is happening.
- 5) User Feedback Including User Surveys Validated Complaints. A survey of users may be performed in order to ascertain that performance standards are being met (e.g., that a standards for reference timeliness and quality are maintained from the user perspective).
- 6) Validated Patron Complaints. Patron complaints should be encouraged, received and verified as a means of assuring the quality of work performed. All complaints should be responded to and the reasons for the problems validated and addressed.

Each of these methods is described in more detail below.

Performance of a required service is considered acceptable when the number of discrepancies found during a surveillance period does not exceed an unacceptable number of discrepancies. Most levels of acceptance found through 100 percent inspection are stated in terms of percentages. The percentages should be computed periodically (usually monthly) by dividing the number of discrepancies by a lot size (usually monthly or quarterly output). For required services inspected by a random sampling, the number of faulty items or services which determine a lot rejection is determined by an acceptance level and statistical quality control methods applied.

In most instances, the acceptance or rejection of performance will be determined by 100% inspection made on a periodic basis (usually monthly). In order to facilitate 100% inspection to observe timeliness, it will be necessary to maintain records (logs) of transactions, so that timeliness of events can be determined. For example, a log might be maintained for each order, recording the date of request, date of order placement, date of return, date of delivery, and so on. The logs (maintained manually or on an automated system) could highlight activities that exceed performance standards of timeliness. In other instances, timeliness of activities such as delivery of periodic reports can be observed through review of each report and its delivery.

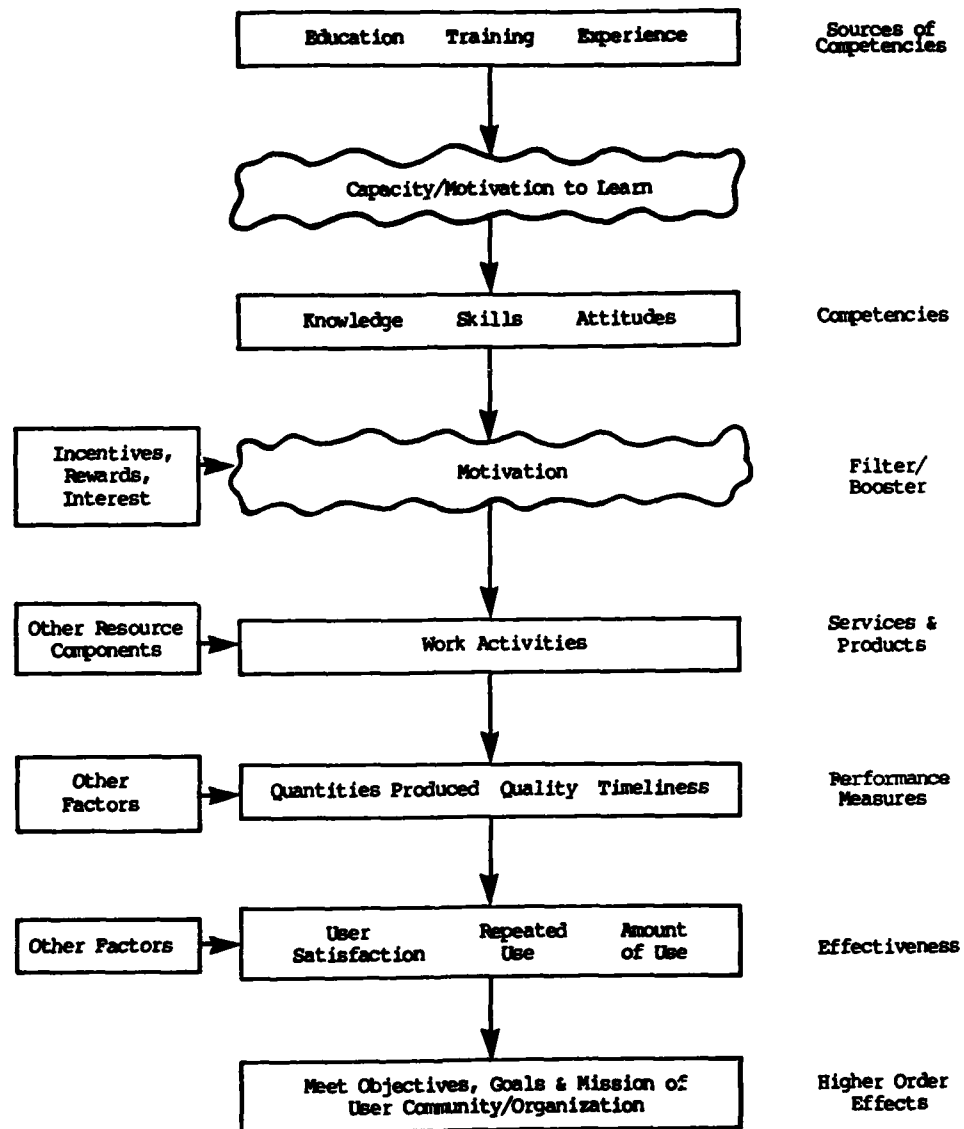
The surveillance records can be maintained in any one of several ways including logs or computer records. Such logs or records should have some mechanism(s) for highlighting events that fall below the acceptance standards. Otherwise, the logs or records must be reviewed monthly to identify instances where the standards are met or not met.

The second principal method of inspection is random sampling. In this case, a periodic (usually quarterly) lot of output is sampled and inspected. For example, the acceptance level of indexing is that no more than five percent of the items indexed shall fail to conform to standards. A supervisor or someone designated by the supervisor should determine whether sample outputs conform to information centre standards.

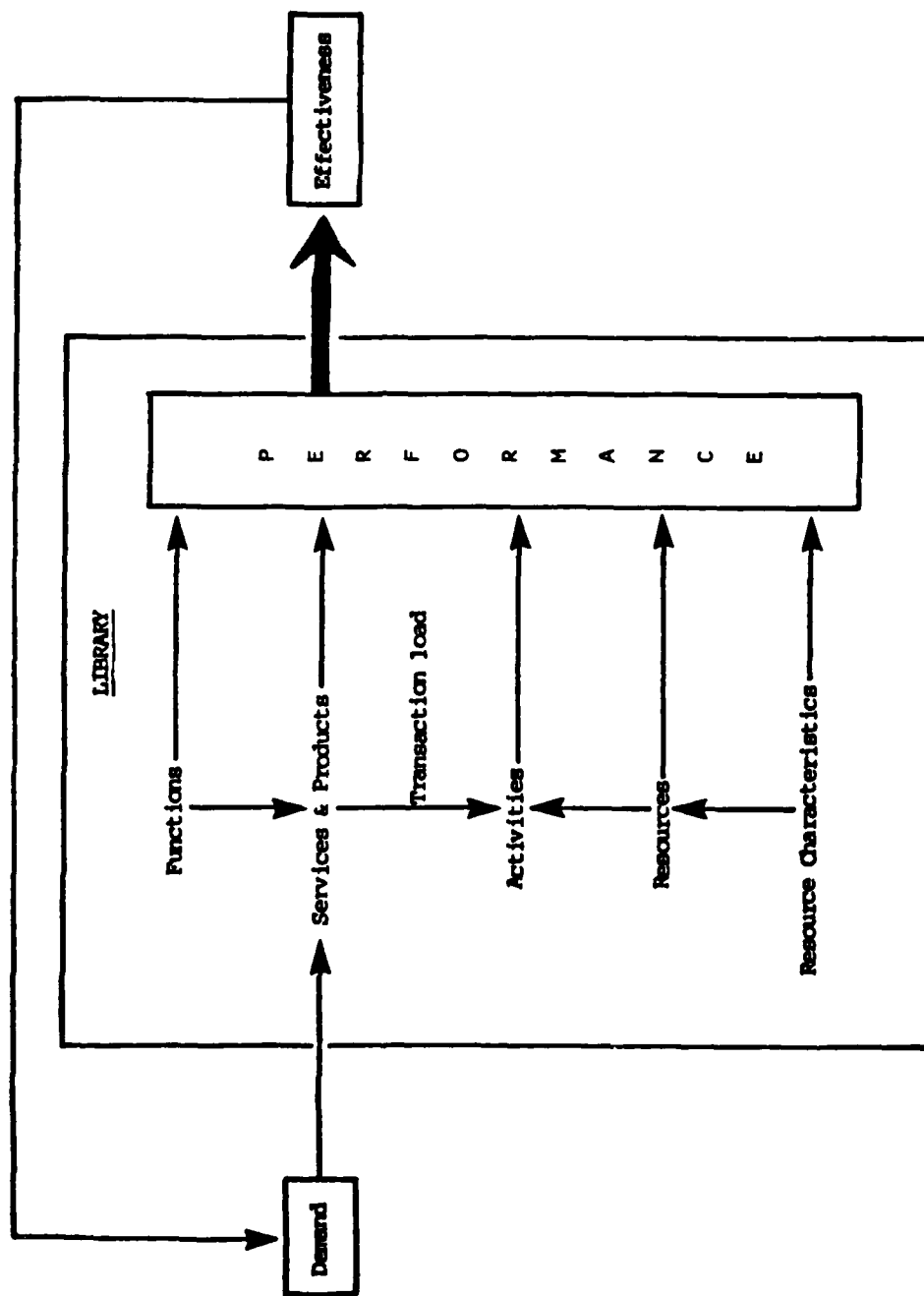
The person responsible for quality assurance should first select the areas and times for random sampling using the procedures in the sampling guides and program these inspections on the schedule. When the sampling procedure does not allow for specific selection of inspection items during the preceeding quarter, it will be necessary to show on the schedule the date and time the sample selection will be accomplished and when the inspections will be conducted. Then program into the schedule the periodic checklist items to be surveilled during the period. This schedule should show what the responsible person is monitoring each day.

Tally checklists should be prepared for each sampling guide and will be used to record information on observations and defects. Each observation in the sampling will be recorded on the tally checklists. These documents will then become a formal record for later reference. The tally of observations and defects at the end of the month will be compared with the acceptable number of defects appearing in the relevant sampling guide. Any errors detected during the course of the surveillance, even if not of sufficient degree to render the service unsatisfactory in terms of the acceptance level parameters, will require corrective action by the supervisor if possible.

In some instances, inspection requires visual observation of activities or events. In order to achieve such inspection, random spot checks of the operation should be made by a supervisor or manager. Such spot checks can be made on a weekly and monthly basis depending on the observation made. Note that the process of spot checks will have the effect of the staff (or contractor) knowing certain activities have to be done and on time.



Relation of Sources of Competencies, Competencies, Services and Products, Performance Measures, Effectiveness and Higher Order Effects



Conceptual Framework for Library Staffing Studies

**SEARCHER COMPETENCIES AFFECT:**

- INPUT COSTS
- OUTPUT PERFORMANCE  
QUANTITIES  
QUALITY  
TIMELINESS

**COMPETENCIES REQUIRED OF INFORMATION PROFESSIONALS TO FACE THE CHALLENGE OF THE INFORMATION AGE**

A COMPETENCY IS A GENERIC KNOWLEDGE, SKILL OR ATTITUDE OF A PERSON THAT IS CASUALLY RELATED TO EFFECTIVE BEHAVIOUR AS DEMONSTRATED THROUGH EXTERNAL PERFORMANCE CRITERIA, WHERE:

- KNOWLEDGE IS HAVING INFORMATION ABOUT, KNOWING, UNDERSTANDING, BEING ACQUAINTED WITH, BEING AWARE OF, HAVING EXPERIENCE OF, OR BEING FAMILIAR WITH SOMETHING, SOMEONE, OR HOW TO DO SOMETHING
- SKILL IS THE ABILITY TO USE ONE'S KNOWLEDGE EFFECTIVELY
- ATTITUDE IS A MENTAL OR EMOTIONAL APPROACH TO SOMETHING, OR SOMEONE

**KNOWLEDGE IS HAVING INFORMATION ABOUT, KNOWING, UNDERSTANDING, BEING ACQUAINTED WITH, BEING AWARE OF, HAVING EXPERIENCE OF, OR BEING FAMILIAR WITH SOMETHING, SOMEONE, OR HOW TO DO SOMETHING.**

- *BASIC KNOWLEDGE* IN SUCH AREAS AS LANGUAGE, COMMUNICATION, ARITHMETIC OPERATIONS, ETC.
- *SUBJECT KNOWLEDGE* OF PRIMARY SUBJECT FIELDS OF USERS SERVED SUCH AS EDUCATION, MEDICINE, CHEMISTRY, LAW, ETC.
- *LIBRARY AND INFORMATION SCIENCE KNOWLEDGE* SUCH AS THE DEFINITION, STRUCTURE AND FORMATS OF INFORMATION, ETC.
- *KNOWLEDGE ABOUT INFORMATION WORK ENVIRONMENTS* SUCH AS THE INFORMATION COMMUNITY, ITS PARTICIPANTS AND THEIR SOCIAL, ECONOMIC AND TECHNICAL INTERRELATIONSHIPS, ETC.
- *KNOWLEDGE OF WHAT WORK IS DONE* SUCH AS THE ACTIVITIES REQUIRED TO PROVIDE INFORMATION SERVICES AND PRODUCE INFORMATION PRODUCTS, ETC.
- *KNOWLEDGE OF HOW TO DO WORK* SUCH AS HOW TO PERFORM VARIOUS ACTIVITIES, APPLY TECHNIQUES, USE MATERIALS AND TECHNOLOGY, ETC.
- *KNOWLEDGE OF THE ORGANIZATION OR USER COMMUNITY SERVED* SUCH AS THE MISSION, GOALS AND OBJECTIVES OF THE USER OR THE ORGANIZATION, USER'S INFORMATION NEEDS AND REQUIREMENTS, ETC.

**SKILL IS THE ABILITY TO USE ONE'S KNOWLEDGE EFFECTIVELY.**

- *BASIC SKILLS* SUCH AS COGNITIVE, COMMUNICATION, ANALYTICAL, ETC.
- *SKILLS RELATED TO EACH SPECIFIC ACTIVITY* BEING PERFORMED SUCH AS NEGOTIATION OF REFERENCE QUESTIONS, EVALUATION OF SEARCH OUTPUTS, ETC.
- *OTHER SKILLS* SUCH AS MANAGING TIME EFFECTIVELY, BUDGETING AND MAKING PROJECTIONS, ETC.

**ATTITUDE IS A MENTAL OR EMOTIONAL APPROACH TO SOMETHING OR SOMEONE.**

- *DISPOSITIONAL ATTITUDES TOWARD ONE'S PROFESSION, THE ORGANIZATION SERVED, ONE'S WORK ORGANIZATION, AND OTHER PEOPLE SUCH AS USERS AND CO-WORKERS.*
- *PERSONALITY TRAITS/QUALITIES SUCH AS CONFIDENCE, INQUISITIVENESS, SENSE OF ETHICS, FLEXIBILITY, ETC.*
- *ATTITUDES RELATED TO JOB/WORK/ORGANIZATION SUCH AS WILLINGNESS TO ACCEPT RESPONSIBILITY, WILLINGNESS TO LEARN, DESIRE TO GROW, ETC*

**ACTIVITIES**

<b>REFERENCE</b>	<b>ENTRY LEVEL</b>
<i>Solicited Searches</i>	
1. Interview users to evaluate information requirements, and determine budgetary and time constraints, etc.	
2. Counsel clients on specifying information requirements	
3. Develop and implement strategy for obtaining, evaluating, packaging information and data to meet users' needs	
4. Select search methods (e.g., online and/or manual)	
5. Determine appropriate source (e.g., databases, printed publications, experts, etc.)	
6. Conduct searches, using proper subject terms for sources selected	
7. Review retrieval output for relevancy	
8. Provide information for users in the form of references or source documents	
9. Translate titles and abstracts	
10. Refer users to higher-level reference staff, as appropriate	
11. Refer users to other information services, as appropriate	
<i>Unsolicited Searches</i>	
12. Perform online searches according to SDI profiles	
<i>Other</i>	
13. Answer ready reference questions	
14. Instruct users in reference methods, sources, services and policies	
15. Alert users to non-print and in-house developed sources of information	
16. Perform bibliographic verification as required	
17. Recommend acquisition of materials for the reference and general collections	
18. Recommend materials/data for inclusion in reference source files (vertical file; in-house indexes)	

# KNOWLEDGE

REFERENCE	ENTRY LEVEL
<i>Solicited Searches</i>	
***knowledge related to literacy, numeracy, communications, etc.	
<i>Subject knowledge</i>	
*knowledge of the primary subject field of users served (e.g., medicine, chemistry, law, etc.)	
*knowledge of foreign languages	
<i>Library &amp; Information Science Knowledge (Generic)</i>	
***knowledge of definition, structure, and formats of information	
*knowledge of alternative approaches to the organization of information	
**knowledge of alternative approaches to retrieval of information	
*knowledge of alternative approaches to information management	
*knowledge of available and emerging information technologies and their applications	
*knowledge of completed and ongoing research in the field and its applicability to practice	
*knowledge of career opportunities	
***knowledge of how to learn on an ongoing basis	
<i>Knowledge about information work environments</i>	
*knowledge of the expanding information community, its participants and their interrelationships (social, economic, technical, etc.)	
knowledge of the variety of work settings and their organizational structures	
*knowledge of the functions performed within the various work settings and the services and products offered	
**knowledge of the users of the services and products, their characteristics and information habits	
<i>Knowledge of what work is done</i>	
***knowledge of the reference function, the range of services and products offered (both actual and potential)	
***knowledge of the activities that are required to offer the services and produce the products	
***knowledge of the various resources that are necessary to support the activities	
***knowledge of reference/referral tools and sources of information	
***knowledge of reference/referral methods and techniques	
**knowledge of performance expected and how it can be measured	
**knowledge of job responsibilities and working conditions (e.g., range of duties, probable compensation, benefits, etc.)	

# KNOWLEDGE

## REFERENCE

## ENTRY LEVEL

### *Knowledge of how to do work*

- \*\*\*knowledge of how to perform the various activities
- \*\*\*knowledge of how to use the reference/referral and other sources
- \*\*\*knowledge of how to apply the reference/referral methods and techniques
- knowledge of personnel procedures

### *Knowledge of the organization served and its library (or information center)*

- \*\*knowledge of the mission, goals and objectives of the organization served
- \*\*knowledge of the structure of the organization and the role of the library (or information center) within the organization
- \*knowledge of the various projects and key personnel within the organization
- \*\*knowledge of the policies and procedures relevant to the library (or information center)
- \*\*knowledge of the various resources available within the library (e.g., personnel, equipment, etc.)
- \*\*\*knowledge of the users' information needs and requirements
- \*\*\*knowledge of the collection, and of related collections

## REFERENCE

## MID LEVEL

- \*\*\*greater depths of knowledge specified above
- knowledge of the operations of other sections in the library and how they relate to reference
- \*\*\*knowledge of available vendor-supplied systems, services and products to support reference
- \*knowledge of the contracting process, both in general and within the organization
- \*\*knowledge of evaluation methods and techniques to evaluate systems, services and products
- \*\*knowledge of public relations techniques

**SKILLS**

REFERENCE	ENTRY LEVEL
-----------	-------------

*Basic Skills*

\*\*\*literacy, numeracy, cognitive, analytical, communications, etc.

*Skills Related to Specific Activities*

## Ability to:

- \*perform *each* activity
- \*\*establish rapport with users and colleagues
- \*\*\*communicate well by written, verbal and non-verbal means
- \*\*conduct an interview
- \*conduct meetings with individuals and groups
- \*collect, analyze and interpret data
- \*\*make decisions and recommendations based on available information
- \*supervise staff
- \*work independently and in groups
- \*develop criteria for evaluation

## Ability to:

- \*\*make effective, timely, and well-informed decisions
- \*isolate and define problems and develop the necessary criteria and action for their solution
- \*\*manage time effectively

REFERENCE	MID LEVEL
-----------	-----------

*Skills Related to Each Specific Activity*

\*\*\*Skills listed above are developed to a greater extent

## Ability to:

- \*\*perceive the needs of the organization and not just the library
- \*\*anticipate long-range needs of library
- \*\*design systems and procedures to improve library operations arbitrate and negotiate

## ATTITUDES

## REFERENCE

*Dispositional Attitudes**Attitudes Toward Institutions*

- \*\*\*Respect for profession
- \*\*Respect for the library
- \*\*Respect for the parent organization

*Attitudes Toward Other People**Toward Users*

- \*\*\*Respect users
- \*\*Like people in general
- \*\*\*Like to help people
- \*Like to meet people
- \*Like to make others feel comfortable
- \*Sensitive to others' needs

*Toward Others in the Workplace*

- \*\*\*Respect co-worker
- \*Like to work with others/as a team
- \*Like to work on own
- \*\*Willingness to draw upon and share knowledge and experience with others
- \*\*Supportive of co-workers
- \*Enjoy managing/supervising others

*Personal Qualities*

- \*\*\*Alertness
- \*Assertiveness
- \*Compassion/Kindness
- \*\*Confidence
- \*Cheerfulness
- \*\*\*Dependability
- \*\*Determination/Tenacity
- \*\*Diplomacy
- \*\*Emotional stability
- \*Fairness
- \*\*Flexibility/Versatility
- \*\*\*Imagination
- \*\*Inquisitiveness
- Leadership ability

## EVALUATING PERFORMANCE OF INFORMATION CENTRE OPERATIONS AND SERVICES

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This paper will discuss evaluation of information centre resources (e.g., staff, equipment, facilities, etc.) in terms of input costs, output performance, and productivity. It presents examples of evaluation of information services (e.g., access to technical reports and other publications, online bibliographic searches, published searches, etc.) in terms of their input costs and output performance. The linking of resource attributes or characteristics (e.g., staff competencies, equipment capabilities, facility layout, etc.) to service input costs and output performance (e.g., quality and timeliness of services) is demonstrated. Thus, Centre managers can make decisions about resources or allocation of funds involving resources in terms of services involved. A management information system for centre management is also described.

In this paper, we provide an example of evaluating information centre operations and services. One of the most rapidly growing technologies in the information field has been online bibliographic searching. There has been dramatic growth in the number of bibliographic databases available online, the number of professionals who use these services, and the average number of searches performed by or for professionals. At one time there was broadly accepted speculation that most online searching would migrate from being performed by intermediaries (reference librarians or information specialists) to being performed by end-users themselves. Extensive efforts have been made to make searching more "user friendly" and to train end-users to perform their own searching. In reality, even though some searching is done by end-users, there simply has been little change from having intermediaries perform searches for users. Organizations that have been particularly diligent in end-user training appear to have merely created a greater demand for searching; however, most of this searching is performed by intermediaries who support end-users. The principal reason that end-users (when trained and when some hands-on experience is acquired) revert to support staff is that such searching is very time-consuming, and the time of managers, scientists, engineers, lawyers, etc. is a scarce resource. If end-users feel that an intermediary can search better and/or faster, professionals are likely to use this resource to save their own time.

We estimate that professionals in the U.S. use reference and research services an average of about 3.1 times per year (or an average of 9.7 uses per professional who use the services). About 17 percent of the transactions are considered to be in-depth reference and research transactions (i.e., not quick look-up). In about 79 percent of the uses, the services were used directly by the professionals; only 21 percent were delegated to a colleague or subordinate.

Users of reference and research services were asked how they benefitted by having a staff member from an information centre perform the most recent research for them. Eighty-three percent said having an intermediary do the search saved them (or their staff) time; in fact, an average of about 7.6 hours per search. About 78 percent of the end-users said that the intermediary could perform the search faster and 64 percent said they could do it better. This level of confidence in delegating searching to the intermediaries is borne out by the satisfaction with searches performed for them.

The number of documents identified on the most recent searches performed by information centre staff tends to be large, particularly when compared with the number of documents obtained and actually read (which are indicators of relevance). Estimated average numbers of documents identified, obtained and read are summarized below by type of document:

Type of Document	Number Identified	Number Obtained	Number Read/Intend to Read
Journal Articles	12.4	6.9	5.9
Books	1.7	1.0	0.7
External Technical Reports	3.8	1.7	1.2
Patent Documents	5.4	2.2	2.0
Conference Proceedings	2.6	0.6	0.5
Other	3.1	1.8	1.7
Total	29.0	14.2	12.0

Journal articles are the most frequently identified type of document (43%) and the most frequently read (49%). The average number of documents identified is 29.0 per search. About 49 percent of these documents are obtained; and most of the ones obtained are, in fact, read (85%). The average number of documents identified (29.0) may seem high; however, looked at across all searches we find that the distribution of number of documents identified is highly skewed. That is, a few searches account for a large number of the documents identified (i.e., 10% of the searches account for about one-half of the documents identified).

Three indicators of searching performance that we observed are:

- o relevance of output to users' information needs,
- o number of references in search output, and
- o time between request and receipt of search output.

End-users were asked if, to their knowledge, there were any relevant documents missed on the most recent search performed for them. For about 26 percent of the searches, the end-user did not know whether relevant documents were missed. For the remaining searches, about 89 percent had no known missed relevant documents. The average number of missed relevant documents was about four per search. End-users said they were satisfied or very satisfied with 89 percent of the searches regarding relevance. As shown in Table 1, the average rating of satisfaction was estimated to be 4.15 (on a scale of 1-5 with 5 representing "Very Satisfied"). End-users were also asked how satisfied they were with the number of references presented to them in the search output (average being 29.0). Here we find satisfaction to be a bit lower (average rating of 4.06), with 84 percent being satisfied or very satisfied. Nearly all of the end-users who were dissatisfied felt they got too many references, as opposed to too few.

TABLE 1

PROPORTION OF PROFESSIONALS WITH VARIOUS LEVELS OF SATISFACTION\*  
WITH ONLINE BIBLIOGRAPHIC SEARCHING DONE BY  
INFORMATION CENTRE STAFF: 1987

Aspects of Online Bibliographic Searching	Satisfaction Level					Average Satisfaction Level
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	
Relevance of output to users' information needs	2.2	0.3	8.7	58.0	30.8	4.15
Number of references in search output	1.9	2.9	11.4	54.7	29.1	4.06
Time between request and receipt of search output	1.7	0.6	5.6	40.6	51.5	4.40

SOURCE: King Research, Inc. Survey of Professionals

\*Satisfaction Scale: 1 = Very Dissatisfied  
2 = Dissatisfied  
3 = Neither Satisfied NOR Dissatisfied  
4 = Satisfied  
5 = Very Satisfied

In terms of timeliness of response, we found that the average time to receive search results is 3.2 days. About 36 percent of the search results were delivered within one day and another 27 percent on the second day. About 20 percent of the searches took over one week to complete. When asked the timeframe within which search results were needed (to achieve the greatest value), most indicated times equal to or greater than the actual delivery time. The average for the required timeframe is 4.9 days (compared with 3.2 actual delivery). Ninety-two percent of the end-users said they were satisfied or very satisfied with the response time of the most recent search performed for them. The average satisfaction rating of 4.40 is higher than ratings for quality of search.

End-users were asked to indicate the importance of intermediaries' knowledge of the subject field searched and intermediaries' skill in conducting the search. About 58 percent of the end-users consider knowledge of subject field to be important or very important. However, searching skill is thought to be more important as 86 percent consider this competency to be important or very important.

User satisfaction is important partially because it means that satisfied users will continue to use information centre services. We have some evidence that amount of searching and user satisfaction are correlated. For example, if we look at satisfaction with relevance of output to information needs, the average amount of searching by those

end-users who are very satisfied is 5.12 searches per year; and for those who are satisfied 3.71 searches per year. For those who are neither satisfied nor dissatisfied, the average number is 2.47 searches per year; the number of searches for those who are dissatisfied is 2.00 searches per year; and for those who are very dissatisfied 0.43 searches per year (see Figure 1). Interestingly, the number of times the professionals use alternative sources for their searches (e.g., searching themselves, delegating to a colleague or subordinate, or using another centre) is inversely correlated to satisfaction with searches performed by information centre staff. For example, those very satisfied with information centre searches average 1.5 other searches; satisfied - 2.3 other searches; and neither satisfied nor dissatisfied - 4.1 other searches. For all three levels of satisfaction the professionals average about four to five searches from all sources per year.

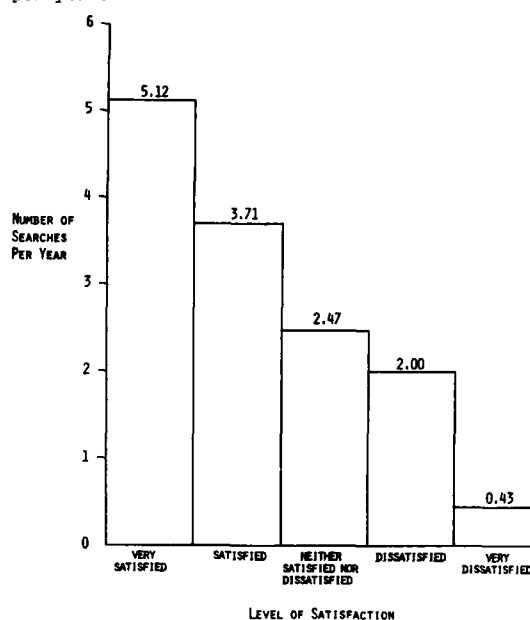


Figure 1. Number of Online Bibliographic Searches Done Per Year Through Library Versus Level of Satisfaction with Relevance of Output to Information Needs

User satisfaction with number of references presented in the search output also has a similar relationship with number of searches. Those very satisfied average about 5.74 searches per year, and those satisfied averaged 3.37 searches per year. The professionals who are neither satisfied nor dissatisfied average about 1.83 searches per year.

With timeliness we can compare satisfaction versus actual response times. For example, we find that average satisfaction ratings go down appreciably as the difference in needed response times and actual response times increases as follows:

- o For responses that are faster than needed time, the average satisfaction rating is 4.45.
- o When the needed and actual response times are the same, the average satisfaction rating is 4.15.
- o When the actual response time is greater than the needed time, the average satisfaction rating drops to 3.09.

Clearly, response time is important when needed time is considered. This is why establishing needed time and meeting this time, if possible, is so important.

Similarly, there is a positive relationship between satisfaction with search response time and amount of searches requested by users. On the average, far fewer searches are performed by those dissatisfied or very dissatisfied with response time (1.81 and 1.50 searches per year, respectively) than those who are satisfied or very satisfied with response time (3.63 and 5.19 searches per year, respectively). This result would suggest that quality of online searches is also more important than timeliness of response. This assertion is reinforced below when we look at the value placed on these two measures of performance.

End-users who were required to pay service charges were asked how much they paid for their searches. The average amount paid was \$260. For 71 percent of the searches, the price was said to be about right; 26 percent said the price was too high; and two percent said it was much too high. This is considered evidence of what professionals are willing to pay for their searches.

In order to establish the relative value of quality and timeliness of online searches, we used a market research tool called conjoint measurement. This method requires users of online searching to make judgements about a set of alternative combinations of search performance attributes: quality, timeliness and price. The performance attribute of quality was specified at three levels: high, medium and low relevance of items retrieved. Timeliness was also specified at three levels: speed of response within a day, between one and three days and over three days. Price was measured at three levels: \$50, \$150 and \$250. As we indicated previously, online searching is delegated by users to information centre staff because users feel that the information centre can save users' time, and the staff can do the searches better and faster.

The relative value of quality and timeliness is displayed in Figure 2.

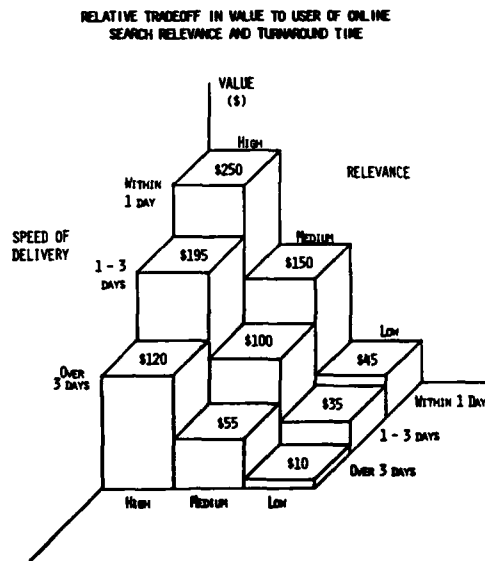


Figure 2. Relative Tradeoff in Value to User of Online Search Relevance and Turnaround Time

If search results are returned within one day, but relevance of items retrieved drops from high to medium, the value decreases from \$250 to \$150. Similarly, if relevance remains high but response time drops from within one day to one to three days, the value drops from \$250 to \$195. Thus, over all combinations of these two performance attributes we estimate that value of quality is greater than value of speed of delivery, although both are appreciable. Low relevance of items retrieved and response time of over three days reduces value to only an estimated \$10. Clearly, both quality and timeliness of response should be kept at a high level when at all possible.

Another indicator of the usefulness of the online searches is the purpose for which searches are performed. Estimates of the proportion of searches done for various purposes are given below.

Purpose of Search	Proportion (%)
Research and development	29
Background research	24
Management or executive work	11
Legal work	9
Marketing, sales or sales management	6
Administration/finance	6
Writing or giving presentations	5
Presentations	3
Consulting or giving advice to others	3
Professional development	2
Other	2
Total	100%

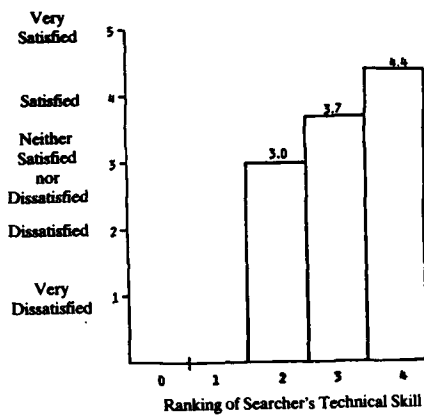
Clearly, the searches are performed for a wide variety of essential work.

Another way of looking at the value of searches performed by information centre staff is how much more it would cost to perform the searches if there were no information centre. We find that about 14 percent of the searches would not have been done. About one-half of the searches would have been done by the professionals themselves. Otherwise, the searches would have been delegated to someone else on the professional's staff (12%), purchased from a broker (11%) or obtained from an external source (13%). The cost of using alternative means of searching is estimated to be about \$145 more than is currently spent on the searches (about \$115). Most of this additional cost is in terms of the users' time (\$105), but some of it is in the additional cost to purchase a search (\$20), someone else's time (\$18) or other expense (\$2).

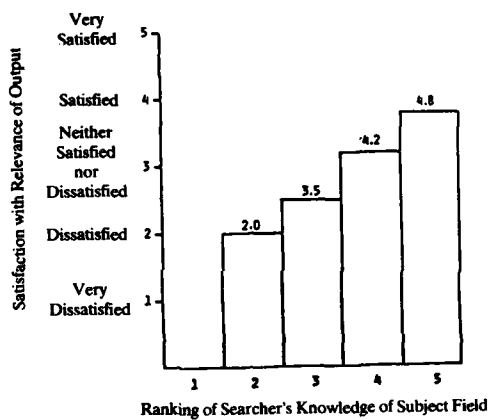
ASPECTS OF ONLINE BIBLIOGRAPHIC SEARCHING	SATISFACTION LEVEL*					AVERAGE SATISFACTION LEVEL*
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	
RELEVANCE OF OUTPUT TO USERS' INFORMATION NEEDS	2.2	0.3	8.7	58.0	30.8	4.15
NO. OF REFERENCES IN SEARCH OUTPUT	1.9	2.9	11.4	54.7	29.1	4.06
TIME BETWEEN REQUEST AND RECEIPT OF SEARCH OUTPUT	1.7	0.6	5.6	40.6	51.5	4.40

SOURCE: KING RESEARCH, INC. SURVEY OF PROFESSIONALS

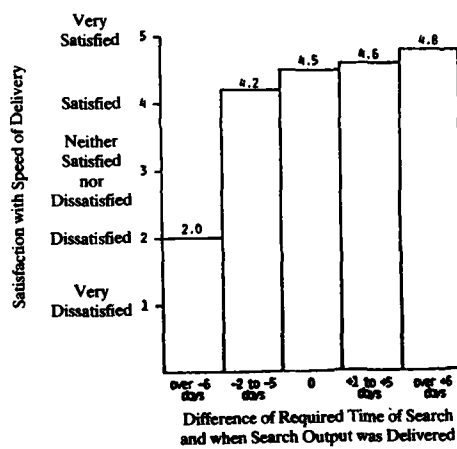
\*SATISFACTION SCALE: 1 = VERY DISSATISFIED  
 2 = DISSATISFIED  
 3 = NEITHER SATISFIED NOR DISSATISFIED  
 4 = SATISFIED  
 5 = VERY SATISFIED



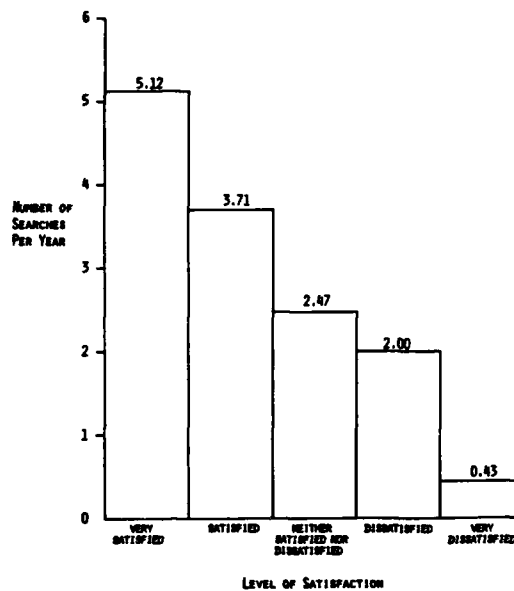
Relation of Search Performance as a Function of the Searcher's Technical Skill



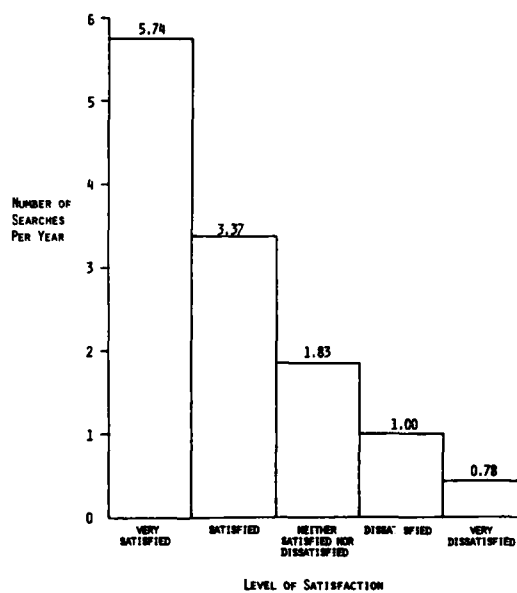
Relation of Search Performance as a Function of the Searcher's Knowledge of Subject Field



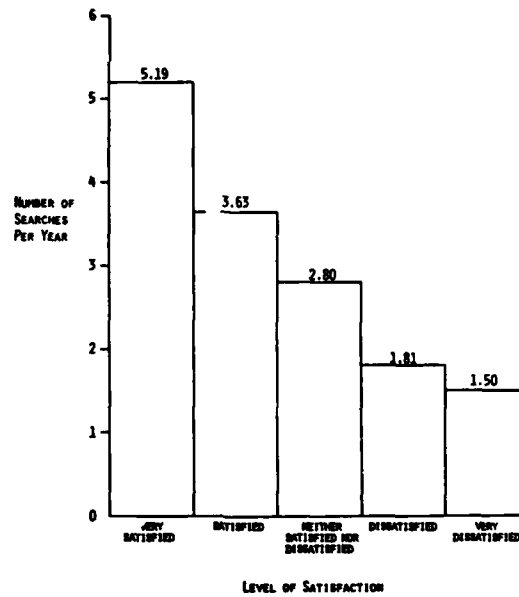
Relation of Search Effectiveness as a Function of Speed of Delivery



NUMBER OF ONLINE BIBLIOGRAPHIC SEARCHES DONE PER YEAR  
VERSUS LEVEL OF SATISFACTION  
WITH RELEVANCE OF OUTPUT TO INFORMATION NEEDS

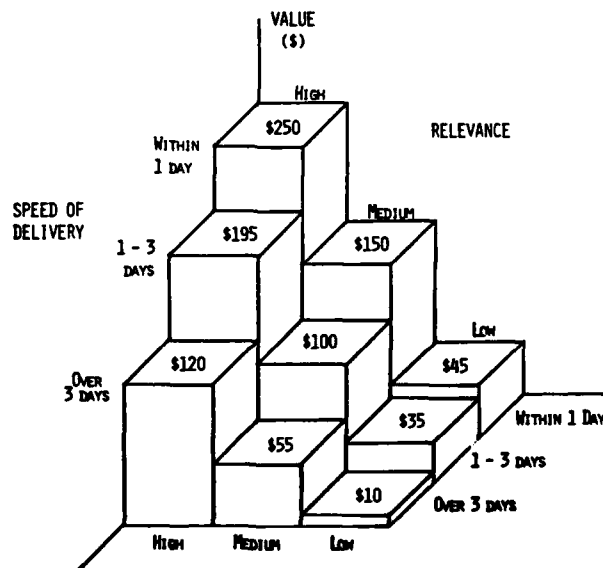


NUMBER OF ONLINE BIBLIOGRAPHIC SEARCHES DONE PER YEAR  
VERSUS LEVEL OF SATISFACTION  
WITH NUMBER OF REFERENCES IN SEARCH OUTPUT



NUMBER OF ONLINE BIBLIOGRAPHIC SEARCHES DONE PER YEAR  
VERSUS LEVEL OF SATISFACTION WITH TIME  
BETWEEN REQUEST AND RECEIPT OF SEARCH OUTPUT

RELATIVE TRADEOFF IN VALUE TO USER OF ONLINE  
SEARCH RELEVANCE AND TURNAROUND TIME



RELATIVE TRADEOFF IN VALUE TO USER OF ONLINE  
SEARCH RELEVANCE AND TURNAROUND TIME

# A FRAMEWORK FOR EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES

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Evaluation is a necessary and integral part of Information Centre management. Evaluation must have a purpose - it is not an end in itself. The need for evaluation derives from the decision-making process which leads to action. Without the possibility of alternative courses of action, one cannot conceive of a need to evaluate. Such decisions can involve an entire organization, information services or resources necessary to provide services or produce information products. Evaluation can be an integral part of the decision-making process for designing or implementing a new system; modifying an existing system; discontinuing a system; or continuous monitoring of system performance and effectiveness.

Evaluation is a subject of considerable attention at the current time. Three principal aspects of evaluation and information are presented here. The first involves the evaluation of information workers and services. The second deals with evaluation from the perspective of users served, their organizations and higher levels of aggregation such as to industries, sectors, the entire nation and all nations. The third aspect is how information and information services affect users. Below, we describe several levels within information service centres. One can perform evaluation at each of these levels (i.e., resource components, activities, services and products, functions and information units). That is, at each level one can measure input of resources (i.e., capital, labor, technology, information, etc.) and output quantities produced. Such output divided by input can provide estimates or indicators of productivity.

The output of information services is one of several input resources to users. The extent to which this input affects output and productivity is of considerable interest. As shown in Figure 1 on the next page, the input resources (including information) affect user activities, their functions, their organizations, and so on, up to the point that aggregated information use and subsequent productivity affects national goals. Below we attempt to show how these interrelationships work. First, several definitions are given.

## Definition of Terms Used in Productivity

In recognition that evaluation terms have different definitions and meanings in various professional fields or specialties, a definition of terms is given below. These definitions are provided to insure a common basis for discussion of productivity.

Service - Services may be found at several levels. Examples of types of services include (1) research or consultancy performed by scientists, (2) information services such as reference or access to a collection, or (3) services provided by administrators. Such services can be subdivided into discrete activities necessary to perform them (e.g., contacting a client, negotiating what is needed, performing the research or searches, reporting results, etc.). Each activity may require several resource components (e.g., staff, equipment, etc.).

Input - There are several input resources necessary to achieve services. These input resources include capital, staff, equipment, instrumentation, facilities, information, supplies, administrative and support staff, etc. Each resource component can be measured in several ways; for example, staff can be measured in Full-Time Equivalents, number of persons, hours of work, or cost (salary, fringe benefits, overhead).

Output - Measures of output services include quantities of output (e.g., oral or written reports, number of times advised, number of searches performed, etc.), quality of service, timeliness of services provided, availability and accessibility of staff, etc.

Productivity - Productivity is a measure of the ratio of output divided by the input. It is formally defined as "a concept that expresses the relationship between the quantity of goods and services produced - output - and the quantity of labor, capital, land, energy, and other resources that produced it - input". (U.S. Department of Labor, Bureau of Labor Statistics, Productivity and the Economy: A Chartbook (Bulletin 2172). Washington, DC: Government Printing Office, June 1983.) Productivity is a measure which links input and output. The weakness of the traditional measure of productivity is that there is an interdependence among amount of input resources, output quantities produced, and other output measures such as quality, timeliness, etc. For example, a person's competency will affect both input (amount of time and cost necessary to perform a service) as well as

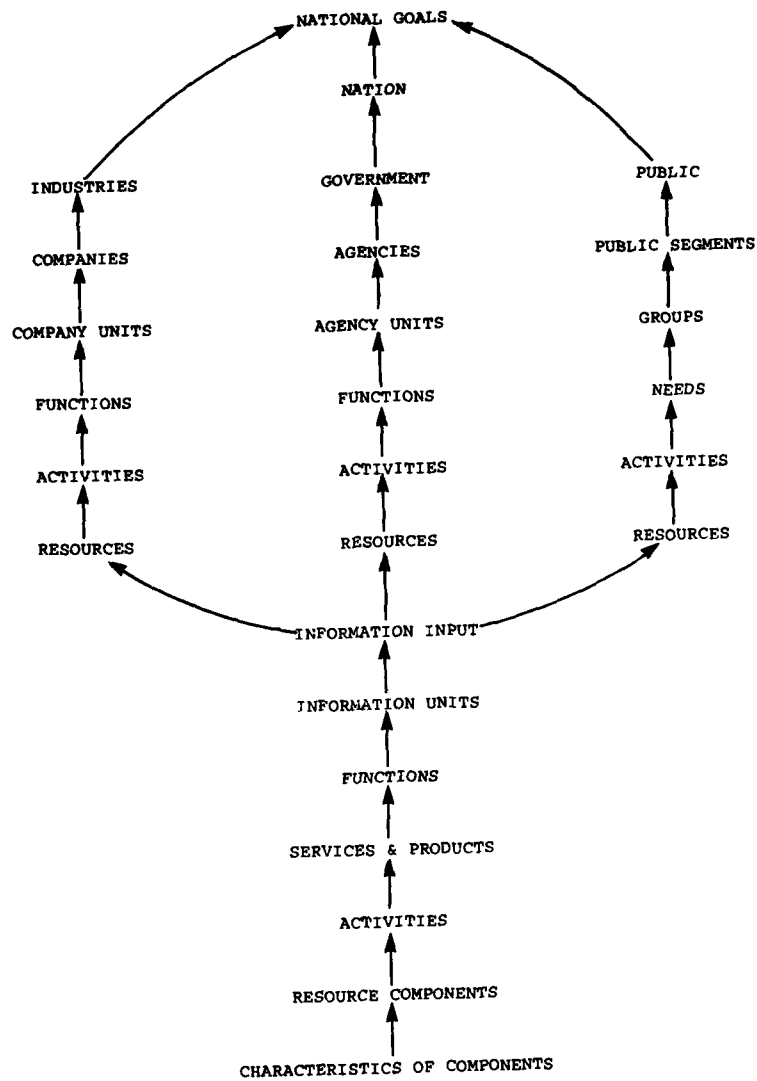


Figure 1. Levels of Information Involvement in Productivity

output (amount, quality and timeliness of service). There is usually an inverse relationship between input (amount of services produced) and service output (quality, timeliness, etc.).

**Performance** - Performance is an indication of how well a service or activity is performed. It can be measured in terms of the output quantities produced, quality, timeliness, availability, accessibility, etc. Other indications of performance are productivity, efficiency (i.e., how close services or activities come to achieving some maximum), etc. Output performance determines the effectiveness of services (see below). Measures of productivity, efficiency, etc., are internal to the service and they are used to manage an operation.

**Effectiveness** - Effectiveness is measured from the perspective of clients or users of the services. Examples of measures of effectiveness include user satisfaction with a service, repeated use of a service and number of times a service is used (first order effects). Higher order effects would include effect of services on the user's research and consequences of the user's research, improved productivity of the user's operation or research, etc. Presumably, improved quality, timeliness, availability, etc. should result in greater user satisfaction, repeated use and the number of times a service is used. Thus, library service output performance partially determines the effectiveness of the service.

**Cost and Benefits** - The cost (i.e., detriments) and benefits of a service are the unfavorable and favorable comparisons of a service and an alternative service in terms of differences in input, output, performance and effectiveness. For example, the value added by the service is that the service costs less than an alternative service, and/or the service is better than an alternative in terms of performance. Such an alternative to a service might be for clients to perform the work themselves or to engage a consultant or company to provide the service.

**Indicators** - Sometimes it is not possible to measure input, output, performance or effectiveness directly. Thus, indicators must suffice. For example, an indicator of the quality of a research project is the number of citations to an article reporting the research. Indicators of a professional's competency are degrees held, university attended, professional awards given, elected position in a professional society, etc.

**Factors That Affect Service Input, Output, Performance and Effectiveness** - Factors that affect input might include staff characteristics, equipment attributes, etc. Examples of factors that might affect output or performance (in addition to amount of input resources) are management (policies, capabilities, attitudes, etc.), physical environment, attitude or capability of clients, etc. Factors that might affect effectiveness (in addition to output performance) are client awareness of, attitudes toward, or perception of a service, a charge for the service, distance to the service, communication constraints, etc. Some factors are internal and, therefore, controllable. Other factors are external and less controllable by management.

**Linkage of Service Input to Output, and Performance to Effectiveness** - By linkage is meant correlation or mathematical models which show that (1) output performance depends on input resources in addition to other factors, (2) first order effects (e.g., frequency of use of a service) depend on output performance in addition to other factors, and (3) higher order effects depend on first order effects. Examples of such analysis and models include correlation and multiple regression, conjoint measurement, factor analysis, multi-aggregate regression, etc.

#### Linking Information Service Centre Performance to User Performance

An example is given below to demonstrate an approach to data collection and analysis for information service centre planning and evaluation. The framework for this example is given in Figure 2. In the framework, one dimension involves three levels of perspective: the information centre's service (e.g., online searching), user (e.g., a scientist conducting research), and all of the scientist's organization (e.g., unit). The second dimension includes (1) input to service or activity, (2) the actual service or activity and its resources, and (3) output of service or activity. In the figure, arrows signify relevant quantitative relationships. For the information centre's service perspective example, the service is online searching and resources are searchers, terminals, search tools, support staff (e.g., to do photocopying, typing, etc.), communication, search systems, photocopying, etc. Associated with the resources are costs which are dependent on attributes of the resources (arrow (a)) and output number, quality, timeliness, etc. of searches (arrow (c)). Likewise, output performance (in terms of number of searches conducted, quality and timeliness) depends partially on the attributes of the resources (arrow (b)). The relationships of resource attributes to input cost and output performance are quite clear. For example, better searcher competencies (i.e., knowledge, skills and attitudes) usually cost more (in salaries) but should also yield more and/or better search output. Performance of online searching can also be measured by cost per search or productivity (searches per hour or cost). These relationships are also designated by arrow (c). Regarding productivity, we feel that it is best to incorporate quality and timeliness with such comparisons, such as by measuring cost per search at levels of quality or at least above an acceptable level of quality and timeliness.

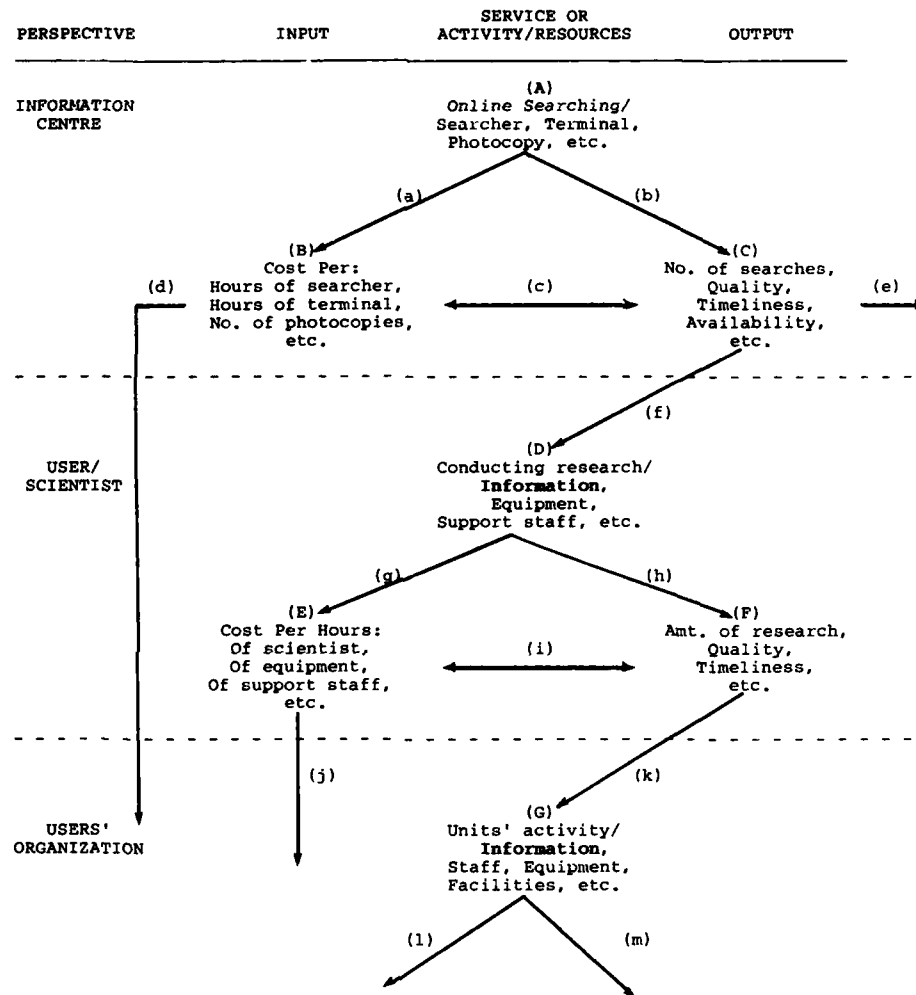


Figure 2. Framework for Collecting Planning/Management Data

Similarly, research conducted by a scientist is given as an example of the user perspective. To perform this activity, in addition to scientist's time, he must have such resources as equipment, instrumentation, facilities, support staff and information. The amount and quality of information used by the scientist depends partially on the output performance of the online search. This relationship is designated by arrow (f). In turn, the amount, quality and timeliness of information will affect cost of performing the activity (arrow (g)) and output amount, quality and timeliness of research (arrow (h)). Productivity of the scientist is shown by arrow (i). Thus, the output of the information service should affect the productivity of scientists. In turn, output performance of scientists' activities should affect the input cost and output performance of their units, and hence, all of the organization (arrows (k), (l), and (m)).

#### Measures and Models

##### Measures

For each information service there are subactivities and resources that are used in the services (A in Figure 2). In addition to the numbers or amounts of the resources, one can characterize them concerning attributes that are likely to affect input cost (B) and output performance (C). Such attributes would include staff competencies (knowledge, skills, attitudes) or indicators of competencies such as educational background, training and years of experience; equipment capabilities such as baud rates, storage capacities, down-time, etc.; photocopy or reproduction quality; microfilm viewer readability; and so on. Cost data can be subdivided into fixed one-time, fixed recurring and variable elements and by direct and indirect costs. Output performance (C) can be identified and measured in terms of quantities produced, quality (probably more than one measure per service), timeliness (probably both by response times and difference in negotiated time and actual time) and any other attributes that might appreciably affect user satisfaction and continued use of the service. We have found that it is sometimes useful to set an acceptable level of performance quality and timeliness so that one can estimate the frequency of unacceptable performance and, perhaps, later implement a quality control program for some services.

In particular, one should identify the activities performed by users and determine the extent (i.e., hours) to which they are performed by users (D). For each activity, the resources used are determined, particularly regarding types of information provided by the information services. We also obtain attitudes concerning the relative importance of information compared to other resources in performing the various user activities. We measure the cost (E) to users of identifying, acquiring and reading information. These costs include user labor, support labor, equipment, purchases of materials, and so on. We also measure indicators of user output associated with each generic activity (F). Such output would include number of proposals or plans written, research reports (e.g., laboratory notebooks) prepared, journal articles or other publications written, consultations done, sales calls made, and so on. In addition, for critical incidents we estimate the contribution that readings (of books, journal articles, technical reports, etc.) have on saving labor and equipment, improving quality or speeding up completion of an activity, and so on. Finally, we measure, to the degree possible, how user performance, in turn, affects the unit's or the organization's total input costs and output performance.

##### Evaluation Models

We have established correlations and other quantifiable relationships between service input costs and output performance; service output performance and user input cost or output performance; user input cost and user output performance; and user output performance and unit/company input costs. These relationships or links are developed largely by multiple regression and conjoint measurement models. Such models can be employed because our surveys yield several hundred observations of critical incidence. The conjoint measurement permits us to determine the relative contribution that service performance attributes make over various levels of the attributes. For example, one can determine how much use would be lost over various combinations of search quality and speed of response.

Each arrow (a, b, ..., j) in Figure 2 represents relationships that will be modelled. Examples of models for each arrow are as follows:

- (a) Cost as a function of searcher competencies
- (b) Quality of search as a function of searcher competencies
- (c) Cost per search or productivity (at acceptable levels and unacceptable levels of quality/timeliness)
- (d) and (j) Contribution of costs to total organization's costs
- (e) Efficiency of resources and service
- (f) Amount of information input as a function of search quality, timeliness, accessibility
- (g) User input cost as a function of information input

- (h) User output performance as a function of information input
- (i) User productivity for various activities as a function of information input
- (k) and (m) Unit input costs as a function of user output performance
- (l) Unit output performance as a function of user output performance

The examples above reflect only dependent and principal independent variables. Other independent variables are introduced to account for other sources of variation. Our experience has shown that the measurable relationships become weaker as the ability to observe or measure becomes more difficult. Nevertheless, we have found positive correlations in most such instances.

Cost and benefit analysis can be done by comparing each information service to its least expensive alternative (or alternative that is likely to be employed by users). Then, by means of the models, one can compare the current service with the alternative concerning: service input costs, service output performance, user input costs, user output performance, and so on. From the perspective of the entire organization, if the comparison is favorable (e.g., costs less), the difference should be recorded in a benefits column, and if it is unfavorable (e.g., less output), the difference should be recorded in a cost (i.e., detriments) column. It is emphasized that the entries of cost and benefit should be in terms of dollar expenditures, other measures (e.g., number of searches, quality of searches, etc.), or merely statements of advantages or disadvantages.

Finally, regression and correlation have been used by Hayes, Terleckyj, Baumol, Braunstein, Jonsher and others to demonstrate that purchase and/or use of information and information equipment or services is correlated to an organization's or industry's productivity. Griliches has also demonstrated the linkage of user productivity (human capital) to the nation's productivity.

#### INDICATORS OF EFFECTS OF INFORMATION

- IMPORTANCE OF INFORMATION AS AN INPUT RESOURCE
- SALARIES POSITIVELY CORRELATED WITH AMOUNT OF READING
- PRODUCTIVITY POSITIVELY CORRELATED WITH AMOUNT OF READING
- OTHER INDICATORS:
  - SAVINGS IN TIME AND EQUIPMENT
  - ACTIVITIES COMPLETED FASTER
  - ACTIVITIES PERFORMED WITH GREATER QUALITY
  - NEW ACTIVITIES INITIATED

## IMPORTANCE OF INFORMATION AS AN INPUT RESOURCE

ACTIVITY	RESOURCE	IMPORTANCE SCORE (1-LOW, 5-HIGH)	
		R & D	OTHER
CONSULTING/ADVISING	COMPUTING EQUIPMENT	3.2	3.3
	INSTRUMENTATION	2.7	3.0
	INFORMATION	3.9	3.8
	SUPPORT STAFF	2.5	3.5
	INFORMATION STAFF	2.5	3.1
	ADVICE FROM CONSULTANT	3.4	3.9
PRIMARY RESEARCH	COMPUTING EQUIPMENT	4.3	3.4
	INSTRUMENTATION	4.5	3.6
	INFORMATION	4.3	3.8
	SUPPORT STAFF	3.5	2.9
	INFORMATION STAFF	2.9	2.6
	ADVICE FROM CONSULTANT	3.8	3.4
SECONDARY RESEARCH	COMPUTING EQUIPMENT	3.0	2.5
	INSTRUMENTATION	2.2	1.9
	INFORMATION	4.6	4.4
	SUPPORT STAFF	2.2	3.1
	INFORMATION STAFF	3.4	3.2
	ADVICE FROM CONSULTANT	3.4	3.2
PROFESSIONAL DEVELOPMENT	COMPUTING EQUIPMENT	3.8	3.4
	INSTRUMENTATION	3.0	2.9
	INFORMATION	4.3	3.9
	SUPPORT STAFF	2.4	3.2
	INFORMATION STAFF	2.9	2.8
	ADVICE FROM CONSULTANT	3.5	3.4

- SALARIES AND SCIENTISTS AND ENGINEERS ARE POSITIVELY CORRELATED TO AMOUNT OF READING DONE

## OTHER INDICATORS OF THE EFFECTS OF INFORMATION

- SAVINGS IN TIME AND EQUIPMENT

	% OF READINGS	AVG. SAVINGS
JOURNALS	25%	\$385
BOOKS	39%	\$280
TECHNICAL REPORTS	72%	\$706

## EXAMPLES OF CONSEQUENTIAL VALUE

- A NUCLEAR SCIENTIST INDICATED THAT A RECENT READING OF A TECHNICAL REPORT ON ELECTRICAL DISCHARGES IN A VACUUM "SAVED TIME BY LETTING ME PERFORM WORK THAT COULD NOT HAVE BEEN DONE OTHERWISE."
- A SCIENTIST INDICATED THAT HIS READING OF A COAL GASIFICATION PROCESSING REPORT "PROVIDED COLLATED INFORMATION IN A SINGLE VOLUME, WHICH MEAN THAT WE DID NOT HAVE TO DO THE COLLATION."
- A BASIC ENERGY SCIENTIST SAID THAT HIS READING OF A REPORT ON DOUBLE EFFECT ABSORPTION COOLING "PREVENTED SAVINGS TO DO A COMPLETE DESIGN OF A SYSTEM INCLUDING DESIGN CALCULATIONS."

## OTHER INDICATORS OF THE EFFECTS OF INFORMATION

- ACTIVITIES PERFORMED WITH GREATER QUALITY

	<u>% OF READINGS</u>	<u>PROP. INCREASE</u>
JOURNALS	31%	160%
BOOKS	48%	55%

## OTHER INDICATORS OF THE EFFECTS OF INFORMATION

- ACTIVITIES COMPLETED FASTER

	<u>% OF READINGS</u>
JOURNALS	4%
BOOKS	14%

## OTHER INDICATORS OF THE EFFECTS OF INFORMATION

- NEW ACTIVITIES INITIATED

	<u>% OF READINGS</u>
JOURNALS	30%
BOOKS	20%

### USER PRODUCTIVITY IS CORRELATED TO AMOUNT OF READING

AMOUNT OF READING IS POSITIVELY CORRELATED TO PRODUCTIVITY MEASURED IN TERMS OF:

- NUMBER OF FORMAL RECORDS OF RESEARCH WRITTEN
- NUMBER OF FORMAL PUBLICATIONS WRITTEN
- NUMBER OF PROPOSALS OR RESEARCH PLANS PREPARED
- NUMBER OF FORMAL ORAL PRESENTATIONS MADE
- NUMBER OF TIMES IN WHICH SCIENTISTS ARE CONSULTED OR GIVE SUBSTANTIVE ADVICE

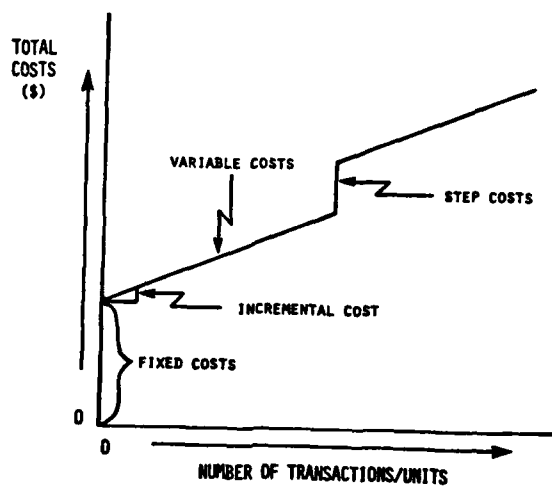
### GLOSSARY OF COST FINDING TERMS

- COST. THE AMOUNT OF MONEY OR OTHER CONSIDERATION EXCHANGED IN ORDER TO PROVIDE A SERVICE, ACTIVITY OR FUNCTION.
- COST FINDING. A LESS FORMAL METHOD (THAN COST ACCOUNTING) OF COST DETERMINATION USING AVAILABLE FINANCIAL DATA AND RECASTING AND ADJUSTING IT TO DERIVE THE COST DATA NEEDED.
- EXPENDITURE. THE COST OF ACQUIRING GOODS AND SERVICES.
- EXPENSE. THE USE OF FINANCIAL RESOURCES FOR PROVIDING GOODS AND SERVICES REGARDLESS OF WHEN EXPENDITURES ARE MADE.
- DIRECT COSTS. COSTS THAT ARE READILY ATTRIBUTABLE TO A SPECIFIC SERVICE, RESOURCE, OR ACTIVITY.
- INDIRECT COSTS. COSTS THAT ARE NOT EASILY ASSIGNABLE OR READILY ATTRIBUTABLE TO ANY ONE SERVICE, ACTIVITY, OR FUNCTION.
  - INDIRECT OPERATING COSTS. THESE COSTS INCLUDE CENTRALLY BUDGETED ITEMS (E.G., UTILITIES, RENT, INSURANCE, ETC.) THAT ARE NECESSARY TO THE GENERAL OPERATION AND MAINTENANCE OF THE LIBRARY SYSTEM.
  - INDIRECT SUPPORT COSTS. COSTS FOR SUPPORT SERVICES THAT BENEFIT OVERALL ADMINISTRATION OF THE LIBRARY SYSTEM AND ITS SERVICES (E.G., ADMINISTRATION, ACCOUNTING, PERSONNEL, ETC.).

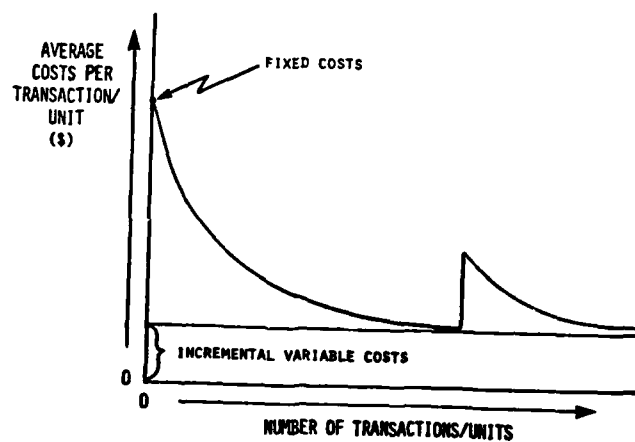
## GLOSSARY OF COST FINDING TERMS (CONTINUED)

- FIXED COSTS. COSTS THAT REMAIN CONSTANT REGARDLESS OF CHANGES IN THE ACTIVITY LEVEL OR METHOD OF PROVIDING THE ACTIVITY.
- SEMI-FIXED COSTS ("STEP COSTS"). COSTS THAT ARE FIXED AT A CERTAIN LEVEL OF ACTIVITY, BUT CHANGE WITH LARGE INCREASES OR DECREASES IN ACTIVITY LEVEL.\*
- VARIABLE COSTS. COSTS THAT CHANGE DIRECTLY WITH CHANGES IN THE LEVEL OF ACTIVITY OR METHOD OF PERFORMING THE ACTIVITY\*
  - LABOR SALARIES. INCLUDES ONLY LABOR TIME ASSOCIATED WITH PROVIDING A SERVICE OR PRODUCING A PRODUCT. (DOES NOT INCLUDE FRINGE BENEFITS.)
  - OTHER VARIABLE. INCLUDES ALL OTHER COSTS ASSOCIATED WITH PROVIDING A SERVICE OR PRODUCING A PRODUCT.
- INCREMENTAL COSTS. THE AMOUNT OF VARIABLE COSTS ASSOCIATED WITH EACH TRANSACTION OR UNIT.
- AVERAGE OR UNIT COST. THE FINANCIAL RESOURCES NECESSARY TO PROVIDE ONE UNIT OF SERVICE.
- DEPRECIATION. A METHOD OF ALLOCATING THE EXPENSE OF AN ASSET TO THE PARTICULAR TIME PERIOD FOR WHICH COST ANALYSIS IS PERFORMED.
- ALLOCATED COSTS. THE DIVISION OF COSTS AMONG SERVICES. FOR EXAMPLE, THE DIVISION OF TERMINAL OR COMPUTER COSTS AMONG CATALOGING, INTERLIBRARY BORROWING, AND ONLINE BIBLIOGRAPHIC SEARCHING.
- FULLY ALLOCATED ACTIVITY COST. THE TOTAL COST OF AN ACTIVITY, INCLUDING BOTH DIRECT AND INDIRECT COSTS.
- ECONOMIES OF SCALE. SITUATION IN WHICH AVERAGE (OR UNIT) COSTS DECREASE FOR INCREASING NUMBER OF TRANSACTIONS OR UNITS OF SERVICES.

## TOTAL COSTS



## AVERAGE COSTS

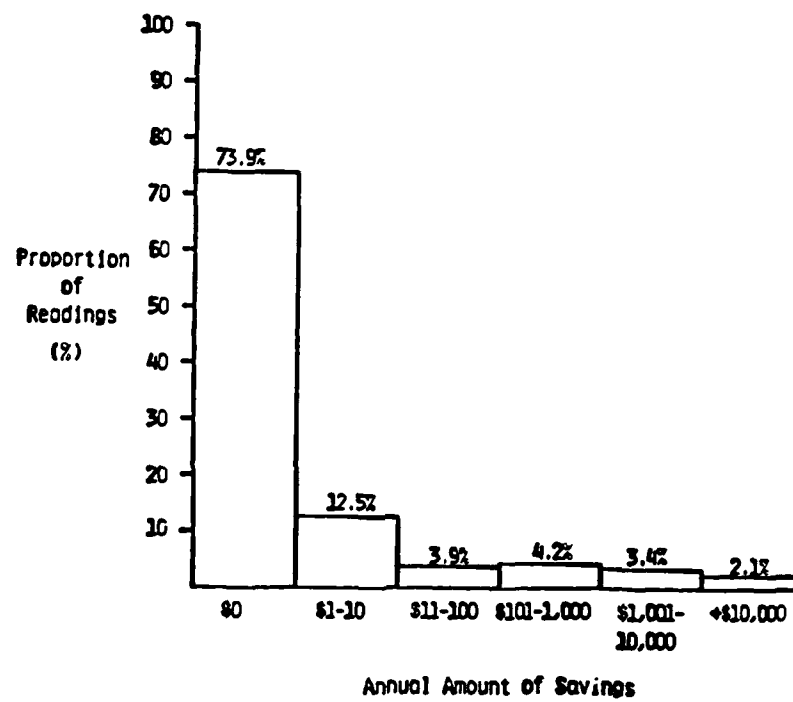


### ECONOMIES OF SCALE

- ECONOMIES OF SCALE DUE TO SPREADING OUT FIXED COSTS
- OTHER SOURCES OF ECONOMIES OF SCALE
  - BATCHING SERVICES FOR OPERATIONAL ECONOMIES
  - OPTIMUM ALLOCATION OF STAFF
- PERFORMANCE AS A FUNCTION OF QUANTITIES OF SERVICE
  - STAFF
  - TECHNOLOGY
- DISECONOMIES OF SCALE
  - ADMINISTRATION
  - COMMUNICATION

TABLE 1  
RESOURCE PERFORMANCE AND EFFECTIVENESS INDICATORS

RESOURCE	INPUT	OUTPUT	OPERATIONAL PERFORMANCE	EFFECTIVENESS	OTHER DERIVED INDICATORS
COLLECTION	Cost (\$) Resources Attributes Additions, withdrawals	Qty. (Titles, Items) Attributes Additions, withdrawals	Cost/Qty	Extent of Use: Circulation In-house (patron, staff) ILL	Cost per capita Avg. cost/level of satisfaction
		Quality (Scope — what covered, comprehensiveness — how well covered)	Qty./Cost	Purpose of use	Cost/extent of use
		Availability (hours available, stock unavailable — in process, on loan, missing, etc.)	Avg. cost/level of qual.	User satisfaction with quality, availability, accessibility	Extent of use/capita Turnover rates
		Accessability (open vs. closed stacks, mis-shelved, etc.)	Avg. cost/level of availability	Fill rates (e.g., title, authors, subject, browsing, etc.)	Avg. use/level of satisfaction
			Avg. cost/level of accessibility	Multiple use Multiple users	Qty./capita ILB/quantities ILB/extent of use Proportion of collection on loan
STAFF	Cost (\$) Resources Attributes Fringe benefits	Qty. (head count, FTEs, hours of work) Attributes	Cost/Qty Qty./Cost	Output of work	Cost/unit of output Cost/capita
		Quality (productivity, accuracy of work, etc.)	Avg. cost/level of qual.	Management of user satisfaction with quality	Avg. cost/level of satisfaction
		Availability (actual hours worked)	Avg. cost/level of availability		
EQUIPMENT & SYSTEMS	Cost (\$) Resources Attributes	Qty. (Amt. of equipment, no. of hours) Attributes	Cost/Qty Qty./Cost	No. of uses No. of users	Cost/capita Cost/use Uses/capita
		Quality (reliability, screen readability, etc.)	Avg. cost/level of qual.	Purpose of use	Hours of use/capita
		Timeliness (response time, baud rate, etc.)	Avg. cost/level of timeliness	User satisfaction with features, quality, timeliness, accessibility	Proportion of total/available hours actually used
		Accessability (no. of hours available)	Avg. cost/level of accessibility		Avg. cost/level of satisfaction
FACILITIES	Cost (\$) Resources Attributes	Qty. (Total space in sq. ft., usable space) Attributes	Cost/Qty Qty./Cost	No. of visits No. of visitor	Cost/visit Cost/capita Cost/hours of use Visits/capita
		Quality (ease of use, pleasantness of surroundings)	Avg. cost/level of qual.	Hours of use	Visitors/capita
		Availability (hours open)	Avg. cost/level of availability	Purpose of use	Hours of use/capita
		Accessability (avg. distance in time or miles to constituents served, amt. of parking, entrance for disabled, etc.)	Avg. cost/level of accessibility	User satisfaction with quality, availability, accessibility	Avg. cost/level of satisfaction



Proportion of Journal Readings in Which Various Levels of Savings are Achieved

## Evaluating for Information Center Planning

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## Summary

A business-oriented approach to information center planning and evaluation is presented. The need for output measures and quantitative expression of service value is described and a method of planning incorporating these concepts is provided. Both top-down and bottom-up planning responsibilities are identified and the specific steps involved in a business planning process are given. The competitive nature of information service operation is emphasized throughout.

## Introduction

All information service organizations operate in a competitive arena -- be they libraries serving the public sector or specialized information centers in government or industrial R&D environments. They all compete with other organizations for finite and scarce resources in a zero-sum game. There are winners and losers, unfortunately, in the competitive arena and the losers are not necessarily the organizations that have the least to offer. They are often the organization least prepared to express their value and contribution in terms understood by the funders.

In business, government and educational institutions, the universal terms understood by all decision makers are cost and benefits as measured in quantitative terms. Lord Kelvin said, "... that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind ...<sup>(1)</sup> The modern executive says, on a similar note, "show me the numbers."

When the U.S. government decided to pull the plug on information analysis centers in the 1970's, the decision was clearly driven by economics. Labor costs were rising and the return on investment of the traditional, labor-intensive approach was not explicitly defined. The move to on-line computer search systems was justified by analyzing costs -- unfortunately, only a portion of the costs got reviewed in that decision. We must assure that future decisions are made with a more complete knowledge of our operations. As leaders of information services we must assure that all operations are fully understood, and that means a clear acceptance of a strong philosophy of quantification. The implications are obvious. Once information service value is accepted as measurable, the positioning of the services, the infrastructure of the service organizations, and the skills needed for its leaders all become quite different from what is considered traditional in information center operation. Given the significant change in orientation that is required, how does a leader begin the process of transforming an operation? I believe the transition begins with a philosophical issue.

## Incompatible Philosophies

Information service providers operate under one of two basically incompatible philosophies regarding the value of their services. The philosophy most common among traditional information managers is that *information organizations are institutions providing services of immeasurable value*. The philosophy required in the modern information center is that *information services/products have a measurable value*. The reason these two philosophies are basically incompatible is illustrated in Table 1 which presents the attributes of organizations operating under each of these world views.

The results of embracing the "measurable value approach" include: the information center becomes a part of the mainstream of the organization; the information center is viewed as an information delivery mechanism rather than a warehouse of information waiting to be used; the managers of these centers work more closely with key decision makers, the information centers compete openly for resources from the same pool as computing centers and management information systems groups.

Bringing about the shift in philosophy requires significant work at all levels in an organization. One sound mechanism for creating such change is via implementing a planning process.

Table 1  
 Comparison of Organizational Attributes of  
 Two Conflicting Information Value Philosophies

Immeasurable Value Approach	Measurable Value Approach
- Organization is justified by qualitative assertions	- Organization is justified by quantitative assertions
- Resources required are quantified	- Resources required are quantified
- Output measures are de-emphasized	- Output is quantified
- Productivity is not (and cannot) be measured	- Productivity is measured
- Link between mission and output is subjective	- Link between mission and output is objective
- Budgets grow/shrink incrementally	- Budgets are constructed programmatically
- Accountability focuses on resources used	- Accountability focuses on input and output measures

### Creating a Planning Environment

To start, it is essential to document the mission of the organization. The mission statement defines the present function, scope, and purpose of the organization in terms understood by its members and those it serves. Creating the mission statement helps to develop a mutual understanding among the managers of the products/services provided by the information organization and begins the process of change. A companion to the mission statement is a "vision" statement which defines the desired future of the organization. It provides a verbalization of the hopes and aspirations of the center management.

Next, it is necessary to determine the positioning of the organization with regard to populations served and those organizations providing competitive services. This means a thorough understanding of all products/services offered by the organization must be developed. These products/services must then be compared to those of the organizations competing in the same arena. Some attributes to aid in such comparisons include cost, speed, quality and complexity.

Forcing an organization to compare *all* of its products and services to other competitive products/services in this manner provides several desirable results:

- a comprehensive list of *all* products/services is developed
- the costs of each product/service must be computed and compared to other (sometimes commercially available) competitors
- attributes considered important in determining distinguishing characteristics (e.g., speed, quality comprehensiveness) must be quantified to be used
- true costs of products/services are understood by the staff providing these services and they do not think of them as free or sunk-cost items
- incremental cost and variable cost concepts can be introduced at this stage to understand the influence of economies of scale

In addition to understanding the products/services, it is essential to understand the user segments served, the size of each segment, the needs of each segment, the source of funding to support services/products for each segment, and the dynamics of these segments. In many cases, the segments served are not connected directly to the funding sources for the information center. This is a case where the "buyers" are not the same as the "customers." Thus, it is important to segment and understand *both* populations and any indirect linkages between the two.

Once the mission, vision, products/services currently offered and market or user segments served have been analyzed, it is time to explore the driving force of the organization. While it is not possible to provide an in-depth understanding of the concept of driving force here, the book by Trego and Zimmerman<sup>(2)</sup> presents a concise and lucid description of the concept. Fundamentally, the driving force of an organization is the central or unifying concept to guide strategy setting at the highest organizational level and at the subcomponent level. The driving force is derived from one of the nine strategic areas in three categories shown in Table 2.

Table 2  
Potential Driving Forces

Category	Strategic Area
Products/Markets	Products/Services Offered Market Needs
Capabilities	Technology Production Capability Method of Sale Method of Distribution Natural Resources
Results	Size/Growth Return/Profit

The importance of the driving force concept is the idea of focus. An organization cannot develop the coherent set of strategies unless it has focus, and the concept of driving force provides this coherence. The strategy at the top of an organization must be compatible with the strategies of each subunit. The overall strategy is the framework which guides the choices that determine the nature and direction of an organization.

What does all this mean? It means that an organization, once it knows its mission and vision and has analyzed its current competitive posture, can begin to chart a course for effectively expressing its goals and objectives in terms that can be understood by numbers-oriented decision-makers. These concepts provide the framework for developing a planning process similar to any valued business.

### Creating the Business Plan

Many information center managers would argue they already have a strategic planning process. Too often this is a long range plan generated by incremental projections of short-range or annual plans or budgets. A true strategic approach, on the other hand, begins with fundamental questions of organization purpose and then builds on the driving force concept. In other words, this approach recognizes the need for strategies developing from the top down and tactics from the bottom up. When this approach is accepted, it is then possible to talk about developing an annual business plan for the organization that involves a coherent set of strategies.

A business plan has a number of components -- many of which have already been discussed in terms of the current state of affairs and the current and desired driving force. A practical outline of the annual business planning process adapted from Leza and Placencia<sup>[3]</sup> includes the components described below:

Organizational Analysis	history, purpose, key players, significant events, current structure and staffing, historical and current trends in funding and service levels, current/new service plans, current/new user groups to be served, technologies used/planned, costs versus other comparable institutions or composite of similar institutions, resources required to provide services, institutional strengths/weaknesses.
Competitive Analysis	other sources for similar services, competitive advantages of institution -- of competitors, rating of competitors as strong/average/weak.
Institution-wide Analysis	current status of centers of a similar type, projected future status in terms of funding sources, range of services offered, size and growth measures, key growth factors, life cycle of various services offered, financial trends.
Market Analysis	for the institution, what is the geographical scope of users served, demographics of the users, how can they be segmented (by information needs, location, funding, etc.), distribution channels used, promotional strategies employed, volume of services delivered, rate of growth of services, share of market served by center versus competitors.
Strategy Setting	specific long-term objectives, performance indicators to measure objective achievement, assumptions, strengths to exploit, weaknesses to overcome or avoid, risks, specific strategies to be used involving technology, users, services, operations, finances, back-up alternatives.
Management Analysis	Identify key functions and who is responsible for each (e.g., public relations, service promotion, service delivery, competitive analysis).
Financial Analysis	Profit and loss statement in terms of detailed description of revenue (from grants, taxes, sale of services, other) and operating expenses; balance sheet listing all assets and liabilities; break-even analysis showing fixed and variable costs versus revenues for various levels of service.
Performance Analysis	compare results to commitments made in business plan and adjust accordingly. Report results in an annual performance report comparing objectives to achievements.

#### Conclusion

This paper is based on previously published material<sup>[4], [5], [6]</sup> concerning information center planning and operation and builds an argument for treating information centers as businesses. They operate in a competitive environment; they need measurable outputs; they require a planning process resembling that of any business; and their operation needs to be monitored on a periodic basis.

It is essential that a thorough evaluation of current information center goals and operations be undertaken before new courses of action are charted. Without a knowledge of current resources (including strengths and weaknesses), new directions can't be planned effectively. The analytical approaches proposed are based on sound business practices and result in the operation of information centers that can base their existence upon a measurable return on investment.

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UTTL: Microgravity User Support Center (MUSC)  
 AUTH: A/MTTMANN, KLAUS; B/SCHMIDT, HANS PETER; C/SCHUBER, MARIANNE  
 PAA: B/(DFVLR, Institut fuer Raumsimulation, Cologne, Federal Republic of Germany); C/(DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany)  
 DFVLR-Nachrichten (ISSN 0011-4901), Nov. 1987, p. 14-18. In German.

ABS: The organization and current activities of the DFVLR MUSC are presented in tables, diagrams, and photographs and briefly surveyed. The primary objectives of the MUSC are to identify and contact new groups of potential users, to make access to space experiments easier, and to reduce costs by making more efficient use of time and facilities. In practice this means assisting users in the design and preparation of experiments, monitoring and controlling the experiments in flight, and evaluating samples and data. The MUSC provides (1) user information services (library, data base, and educational programs), (2) ground versions of the SpaceLab equipment, (3) an experiment control room, and (4) support for interuser communication and cooperation (e.g., access to specialized hardware or analysis of specimens). A list of Eureca-1 experiments being supported by the MUSC is included. 87/11/00 88A23519

UTTL: Microgravity research and user support in the Space Station era - The Microgravity User Support Center  
 AUTH: A/MTTMANN, K.; B/SCHMIDT, H. P.; C/FEUERBACHER, B.  
 PAA: C/(DFVLR, Cologne, Federal Republic of Germany) IAF, International Astronautical Congress, 38th, Brighton, England, Oct. 10-17, 1987, 15 p.

ABS: The organizational structure, objectives, and functions of the Microgravity User Support Center (MUSC) created in Cologne, FRG, jointly by the Institute for Aerospace Medicine, Institute for Space Simulation, and Institute for Materials Research are reviewed. The functions of integrated user support implemented at MUSC closely link scientific and technical tasks for support of experiments and evaluation with operational tasks to support experimental performance during the mission. These functions include user information, experiment preparation, flight experiment operations, and scientific support. The current status of the MUSC and future prospects are discussed.

RPT#: IAF PAPER 87-390 87/10/00 88A16061

UTTL: Technical and Management Information System (TMIS)  
 AUTH: A/RAU, TIMOTHY R.  
 PAA: A/(NASA, Washington, DC) CORP: National Aeronautics and Space Administration, Washington, D.C. AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987, 10 p.

ABS: The TMIS goals developed to support the Space Station Program (SSP) mission requirements are outlined. The TMIS

will provide common capabilities to all SSP centers and facilitate the flow of technical and management information throughout the program as well as SSP decision-making processes. A summary is presented of the various TMIS phases.

RPT#: AIAA PAPER 87-2217 87/06/00 87A48600

UTTL: Value added services - The industry and the user  
 AUTH: A/WILSON, C. L.  
 PAA: A/(Michigan, Environmental Research Institute, Ann Arbor) IN: International Symposium on Remote Sensing of Environment, 18th, Paris, France, October 1-5, 1984, Proceedings, Volume 1 (A86-21101 08-43). Ann Arbor, MI, Environmental Research Institute of Michigan, 1985, p. 377-380.

ABS: 'Value added service' is viewed from the perspective of the operations of the Earth Resources Data Center (ERDC) of the Environmental Research Institute of Michigan. 'Value added service' is defined and the market described in terms of size and customer mix. The industry and the user are described as are their attitudes and interests. The issues affecting Value Added Services, as perceived by the author, as they have occurred in the past and extrapolated to the future are presented. Finally, the concerns of the value added industry for the future are discussed. 85/00/00 86A21133

UTTL: Information needs analysis for the Aeronautical Systems Division Executive Information System  
 AUTH: A/LENTINI, KENNETH J. CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

ABS: The purpose of this study was to determine, using Datortsky's design and planning methodology, the adequacy of the information provided to the executive managers at ASD. To accomplish this objective, a sample of executive managers from ASD was interviewed to determine information needs against the information available. The results indicate that staff executives are receiving the information they need in the form which they prefer, while the line executives lack the automated data they need. Research also revealed that most ASD executives are not satisfied with the Automated Management System for many reasons such as lack of current data. The objective of this thesis was not to solve the information requirement problems of the ASD executives. Rather it was intended to be the first step in a series of research efforts leading to a solution to these problems.

RPT#: AD-A186912 AFIT/GSM/LSMA/87S-42 87/09/00 88N17556

UTTL: Critical issues in NASA information systems CORP: National Academy of Sciences - National Research Council, Washington, D. C.  
 ABS: The National Aeronautics and Space Administration has developed a globally-distributed complex of earth resources data bases since LANDSAT 1 was launched in 1972. NASA envisages considerable growth in the number, extent,

and complexity of such data bases, due to the improvements expected in its remote sensing data rates, and the increasingly multidisciplinary nature of its scientific investigations. Work already has begun on information systems to support multidisciplinary research activities based on data acquired by the space station complex and other space-based and terrestrial sources. In response to a request from NASA's former Associate Administrator for Space Science and Applications, the National Research Council convened a committee in June 1985 to identify the critical issues involving information systems support to space science and applications. The committee has suggested that OSSA address four major information systems issues: centralization of management functions, interoperability of user involvement in the planning and implementation of its programs, and technology.

RPT#: NASA-CR-182380 NAS 1.26:182380 PB88-101027 87/06/00 88N16577

UTTL: Toward an artificial intelligence environment for DTIC (Defense Technical Information Center): Proposed tasks, recommended configurations, projected start-up costs

AUTH: A/KUHN, ALLAN D. CORP: Defense Technical Information Center, Alexandria, Va.

ABS: This report discusses candidate Artificial Intelligence (AI) tasks for initiating AI projects at DTIC, several configuration issues, and start-up costs of expertise and equipment. Configuration issues concern mission, organization, and system. The DTIC AI mission will focus on prototyping practical applications of high value to the DTIC user community. DTIC has the choice of establishing a wholly self-contained AI activity, or participating in, contributing to, and sharing the resources of the Defense Applied Information Technology Center (DAITC). Coordinating AI functionality will be necessary for incorporating AI development activities and implementations on the DOD Gateway Information System (DGIS), the core computer system to the DAITC. Workstation consultant mode and backend storage are two options for production programs management. Two cost projection models are given as start-up costs for an AI environment. The costs are for expertise and hardware/software. AI expertise and AI were mutually dependent for a strong AI environment.

RPT#: AD-A181103 DTIC/TR-87/13 DTIC-AI-FOUNDATIONAL-SER-3 87/05/00 87N27552

UTTL: Benefits of scientific and technical information services for aerospace and defense

AUTH: A/LAURENCE, BARBARA CORP: American Inst. of Aeronautics and Astronautics, New York, N.Y. In Advisory Group for Aerospace Research and Planning and Designing Effective Defence and Related Information Services 4 p (SEE N87-26875 20-82)

ABS: The benefits of having an aerospace and defense scientific

and technical information service are considered based on an understanding of the literature in the field. The functions of a centralized information center and the nature of the research and development process are discussed. 87/04/00 87N26677

UTTL: The information scene in Turkey

AUTH: A/KAYA, D.; B/TUNGER, N.; C/URUNDUL, E. C/(Scientific and Technical Research Council of Turkey, Ankara.) CORP: Ministry of National Defence, Ankara (Turkey). In Advisory Group for Aerospace Research and Planning and Designing Effective Defence and Related Information Services 3 p (SEE N87-26875 20-82)

ABS: After a brief overview of the Turkish information scene and library system, the three most important information centers are described in detail. General problems and shortcomings in the information process are discussed. Specifically, the lack of consciousness and appreciation of the importance of information is stressed. 87/04/00 87N26676

UTTL: The success or failure of management information systems: A theoretical approach

AUTH: A/CURLEE, T. R.; B/TOWN, B. T. CORP: Oak Ridge National Lab., Tenn

ABS: Work has been done by various disciplines to address the reasons why modern, computerized management information systems either succeed or fail. However, the studies are not based on a well-defined conceptual framework and the focus has been narrow. This report presents a comprehensive conceptual framework of how an information system is used within an organization. This framework not only suggests how the use of an information system may translate into productivity improvements for the implementing organization but also helps to identify why a system may succeed or fail. A major aspect of the model is its distinction between the objectives of the organization in its decision to implement an information system and the objectives of the individual employees who are to use the system. A divergence between these objectives can lead to system under-utilization or misuse at the expense of the organization's overall productivity.

RPT#: DE87-007802 ORNL/TM-10320 87/03/00 87N24233

UTTL: Livermore risk analysis methodology: A quantitative approach to management of the risk associated with the operation of information systems

AUTH: A/GUARRO, S. B.; B/GARCIA, A. A.; C/WOOD, C. C.; D/PRASSINOS, P. G. CORP: Lawrence Livermore National Lab., Calif.

ABS: Risk assessment methods vary in nature and depth. Their application to the evaluation of information security issues should be decided on the basis of their capability to provide answers to practical and fundamental questions concerning the design and implementation of security controls in specific information systems. Quantitative

risk analysis provides an objectively based approach to the problem of assessing and managing risk. As a decision making and risk assessment tool, it is not only capable of identifying potential losses that could be unacceptable for a given system, but it can be used to determine which specific security controls and countermeasures can be effective and cost justifiable. The Livermore Risk Analysis Methodology (LRAM) was developed to cover these objectives in a balanced and comprehensive way. Its model and procedures, from the identification of valuable assets to the prioritization and budgeting of proposed controls, are examined and discussed both from the technical and from the decision making/risk management perspectives.

RPT#: DE87-006828 UCRL-95133 CONF-8610255-1 86/08/14 87N24232

UTTL: Engineering information management in a distributed environment

AUTH: A/TRUST, S. R. CORP: Lawrence Livermore National Lab., Calif.

ABS: Lawrence Livermore National Laboratory's (LLNL) Computer Integrated Manufacturing (CIM) project's goal is to implement a wide variety of Computer Aided Engineering (CAE) systems to support our engineering staff. As we move to routine operation, we are addressing the problems of integrated information flow. This paper describes how Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), analysis, and information systems interact and provide vital information, such as drawing release status, production job information, and analytical data. LLNL's information systems must handle a wide spectrum of classified and unclassified data in both paper and electronic form. The range of systems includes terminals, PC's, minicomputers, networks, and mainframe supercomputers. A natural progression toward stand alone engineering workstations, PC based CAD systems, and multiple vendors is occurring. Thus, we are taking steps to ensure that we retain system compatibility. Many such information systems have been attempted. Because results have not always been positive, we are using a pragmatic bottoms up approach to assure success. By beginning with small subsystems, and progressing to full integration, we ensure smooth information flow and provide users with information necessary for decision making. The path to data integration is strewn with obstacles and hazards. We describe many of these and the steps we are taking to remove them.

RPT#: DE86-013022 UCRL-94830 CONF-861099-1 86/07/10 87N18340

UTTL: Systematic corporate planning at DTIC (Defense Technical Information Center)

AUTH: A/CHASTAIN, GEORGENE C.; B/PARRIS, R. R. CORP: Defense Technical Information Center, Alexandria, Va.

ABS: The Defense Technical Information Center (DTIC) has recently committed itself to a long-range corporate planning process. The purpose of this technical report is

to describe this corporate planning process, to document those steps DTIC has taken to implement the corporate plans, and to present lessons learned for use in future planning endeavors.

RPT#: AD-A171525 DTIC/TR-86/19 86/08/00 87N15902

UTTL: Microcomputer-based local automation model: System planning guidance

AUTH: A/HART, R. W.; B/CONNOR, D. J. CORP: Logistics Management Inst., Bethesda, Md.

ABS: Guidance is provided to Department of Defense libraries and information centers on implementing the microcomputer-based Local Automation Model, an integrated library system that includes intelligent gateway technology to search, download, analyze, merge and output citations from multiple databases. The document draws on the experience gained in implementing the micro-Lam prototype at the Technical Library, Headquarters US Army Training and Doctrine Command (HQ TRADOC) and provides an outline of tasks to be addressed in implementing the system at other installations. Tasks include deciding which functions to automate, determining requirements for peripheral equipment, and analyzing telecommunications and electrical requirements. Cost estimates for the system are also included.

RPT#: AD-A168136 LMI-DL503 DTIC/TR-86/13 86/05/00 87N11630

UTTL: Analysis of the use of Defense Technical Information Center resources by research and development centers and laboratories in the US Army

AUTH: A/HUBBARD, R. V.; B/ZACCARDO, K. F. CORP: Presearch, Inc., Fairfax, Va.

ABS: This report describes the methodology, findings, and recommendations of a study of the use of Defense Technical Information Center (DTIC) resources and services by organizations in the Army Research and Development (R&D) Community. The purpose of the study was to investigate Army R&D use of and contribution to DTIC information resources and services, assess the benefits that the availability and use of DTIC resources provides to Army R&D, and develop recommendations for actions the Army might take to use and support DTIC more effectively.

RPT#: AD-A168441 TR-694 85/11/08 86N33203

UTTL: Corporate Data Network (CDN) data requirements task: Preliminary strategic data plan

Co., Washington, D.C.

ABS: Background of the data requirement tasks: Objective of the strategic data plan; overview of the Corporation Data Network (CDN) and the logical data bases in the CDN; approach to plan development; evaluation criteria and methodology; qualitative factors which potentially affect developing priorities; development strategy; and schedule and budget estimates are summarized.

RPT#: TI86-900472 NUREG/CR-4322-VOL-4 85/11/00 86N29727

- UTTL: Information resources management in the R and D environment  
 AUTH: A/BIJERK, K. CORP: FachInformationszentrum fuer Energie, Physik, Mathematik G.m.b.H., Egenstein-Leopoldshafen (West Germany). In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 4 p (SEE N86-28793 19-82)  
 ABS: Efficient management of highly specialized information is a permanent task of optimization, whereby framework conditions may constantly change on account of various influencing factors. Owing to their special significance, the following has to be considered in particular: user needs, available resources, and information techniques. The task of optimization, due to its complexity, cannot be solved model-like, but only approximately and pragmatically. Illustrated by the example of the Federal Republic of Germany and the FachInformationszentrum Energie Physik Mathematik (FIZ) the attempt to find a practical solution is demonstrated. In this context it is shown which role a National Information Center plays within international and national cooperation including worksharing, and how information supply and dissemination of information works in the case of central information services by FIZ, and decentral dissemination of information in research centers. Illustrated by the examples of database production, online services of bibliographic, numeric and full-text databases and the concept of the International Information Network for Science and Technology (STN International), the importance of the use of the most modern information techniques is demonstrated. 86/01/00 86N28803
- UTTL: New technologies for improved information systems and services  
 AUTH: A/GAUTHER-VILLARS, G. CORP: BULL, Louveclennes (France). In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 12 p (SEE N86-28793 19-82)  
 ABS: Information data bases are growing exponentially both because of the number of records and because of the type of data. The number of occurrences encompassed by a data base has an evident influence on its volume, but as one moves from coded data to textual data and to images the need for space grows as well. Data is dear to the user. It is expensive to capture and it is important that it reaches all applications which needs it. So to keep the whole problem of data management under control storage, processing and transfer techniques evolve rapidly. This paper is focused on three important technological breakthroughs in each of these domains: a new storage technique, the optical disc; a new way to process data, the expert systems; and a new way to exchange data, with query languages. 86/01/00 86N28802
- UTTL: The ideal information system? What does the user really want?
- AUTH: A/VANAUSTRIVE, G. M. CORP: Royal Library of Belgium, Brussels. In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 4 p (SEE N86-28793 19-82)  
 ABS: In planning future information systems, it is of utmost importance to take into account the user who finally decides on the success of the systems. So far, system improvements have mainly been implemented with the experienced user in mind. Therefore, if the information systems want to get a better penetration, they will have to implement interfaces facilitating the accessibility of the information by the non-experienced user. Also, access to those idealized information systems could be improved through better cooperation between telecommunication authorities. 86/01/00 86N28801
- UTTL: Measuring the value of information and information systems, services and products  
 AUTH: A/KING, D. W.; B/GRIFFITHS, J. M. CORP: King Research, Inc., Rockville, Md. In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 15 p (SEE N86-28793 19-82)  
 ABS: An approach for measuring the value of information and information systems, services and products is presented. Results of four research projects that have measured value of recorded information used by professional such as scientists, engineers, managers, etc. are also discussed. Furthermore, data are given on the value of such systems and services as a bibliographic database of international publications, online search systems and libraries. The approach used to measure value includes several perspectives. The first perspective is what users are willing to pay for information in terms of money (if exchanged) and the price paid by users in terms of their time and effort to get and read the information. Once information is read and assimilated, there are many purposes for which it might be used such as in one's work, to educate oneself or others, to satisfy one's curiosity, etc. The consequential value resulting from information use is partially measured by the savings that are derived from informational use. Higher order values are how the consequential value affects the user's organization and, in turn, society. 86/01/00 86N28799
- UTTL: The costs of not having refined information  
 AUTH: A/BARRETT, A. J. CORP: Engineering Sciences Data Unit, London (England). In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 9 p (SEE N86-28793 19-82)  
 ABS: The adequacy of the information resources, which are called upon for support at decision points in the research-design-production-marketing process, can in part be measured by their scope, the presence or absence of information within that scope and, increasingly, by the extent to which they offer refinement in terms of the timeliness and quality of the information which can be

retrieved. Timeliness in the present context relates not so much to the response time of the information system as to the extent to which that system is tuned to the volatility of the information which it contains. Likewise, the quality of information is not to be judged only by its relevance and authenticity but also by the convenience of its form of presentation in the view of the decision maker who has need of it. The main focal points of the paper are the costs, disruption and other losses which arise from a lack of knowledge of previous work, the use of out-of-date technical information and, in particular, the extent to which the use of insufficiently refined numerical data leads to the under-, or over-, design of hardware. These are illustrated by a number of quantified examples. The transition from an industrially based to an information or service based society highlights the growing needs of the R&D decision maker and others for systems which will provide high quality numerical and factual data. However, substantiation of these needs may never be available in terms of evidence of direct future benefits as distinct from evidence of historic losses. More dynamic means of demonstrating the impact of information quality upon the interests of the decision maker must be devised and guidelines for two such projects are suggested. 86/01/00 86N28798

UTTL: Information services: Pros and cons  
AUTH: A/YOUNG, L. CORP: Office of the Under Secretary of Defense for Research and Engineering, Washington, D. C.  
In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 8 p (SEE N86-28793 19-82)

ABS: A strong science and technology base is a national necessity in a competitive world, and adequate communication is a prerequisite for it. An individual, be it a policy maker, program manager, a bench scientist or engineer resorts to the information system if he believes it will save him or her time to first consult the written record rather than to undertake a repetitious experiment or investigation. The three components to an effective information service are the sources (those who provide or produce information), the users (those who need the information) and the professional information specialists (those who bind the whole system together). The cooperation toward information exchange of all those connected with research and development must be enlisted in support of the system of which they are a part. 86/01/00 86N28797

UTTL: The information needs of scientists and engineers in aerospace  
AUTH: A/RAIT, D. I. CORP: Raitt (D. I.), Den Haag (Netherlands). In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 5 p (SEE N86-28793 19-82)  
ABS: A brief description of a recent research project to

ascertain the communication and information-seeking and use habits of scientists and engineers working in aerospace research establishments and other organizations is given. Relevant organizations studied include DFVLR, NLR, CNES and ESA. Following an overview of the basic characteristics of scientists and engineers, a review of the project's major findings as they relate to the type of information required by scientists and engineers, its availability, the sources - both oral and written - from which the information is obtained and the scientists and engineers' awareness of them, how they keep up-to-date, the time spent seeking information, the use made of the library and the communication patterns of scientists and engineers, is then given. Some general suggestions for improving the communication and information flow within organizations to the satisfaction of practicing scientists and engineers are made. 86/01/00 86N28796

UTTL: A programme manager's needs for information  
AUTH: A/MASON-SMITH, I. CORP: NATO Integrated Communications System Management Agency, Brussels (Belgium). In AGARD The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 8 p (SEE N86-28793 19-82)  
ABS: The underlying basis for the information need of the programme manager within the NATO Integrated Communications System Agency (NICSA) is examined in some detail, in terms of the role of that agency as exemplified by its current charter. The various specific needs of the program planner working within this framework are then identified and critically reviewed. Finally, the paper notes the expanding role of the remodelled agency (NACISA) to include the development of both communications and information systems for NATO; in this context, the urgent need to re-examine the basic information requirements of the Agency is encouraged and proposals sought. 86/01/00 86N28795

UTTL: The policy maker looks at information  
AUTH: A/SCOTT-WILSON, J. B.: B/HASINSKI, J. P. CORP: British Aerospace Public Ltd. Co., Weybridge (England). In its The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes 9 p (SEE N86-28793 19-82)  
ABS: The policy making hierarchy within British Aerospace is described and the information routes to and from an intermediate level policy maker (Divisional Technical Director) are examined. The information paths for two typical research projects are considered as examples: the use of aluminum/lithium alloys as structural materials and the initiation and development of a new aircraft project. Information quality and the use of automated techniques by policy makers are also discussed. 86/01/00 86N28794

UTTL: The Value of Information as an Integral Part of Aerospace and Defence R and D Programmes CORP: Advisory Group for Aerospace Research and Development, Neuilly-sur-Seine (France).

RPT#: AGARD-CP-385 ISBN-92-835-0389-9 AD-A166641 86/01/00 86N28793

UTTL: Technical information appropriate for developing countries: Selected abstracts from the NTIS (National Technical Information Service) database, 1982-1984 supplement, January 1986

AUTH: A/TENNEY, S. D.: B/CARROLL, E. CORP: National Technical Information Service, Springfield, Va. Sponsored by Agency for International Development

ABS: Documentation was created to support the transfer of technology to developing countries. NTIS performed a search of its database for reports placed into the system between 1982 to 1984 which were determined to be useful in the developing world. The 1986 edition lists over 2500 citations with abstracts and should be read in conjunction with the 1983 edition of the Bibliography of Appropriate Technology Information for Developing Countries (PB83-113852). Citations were selected for their applicability to local development problems in the Third World. The technology chosen can be adapted and applied to help solve development problems and foster self-reliance among low income groups. Categories cover low and intermediate technologies, labor-intensive technologies, social and management technologies and selected modern technologies. A number of management planning reports are included to assist planning in the countries involved. It was developed for use by business and industry, extension centers, research and educational institutions and consultants and policy planners.

RPT#: PB86-122058 86/01/00 86N28787

UTTL: How Ebenezer Scrooge and Peter Drucker are helping shape DoD's Scientific and Technical Information Program

AUTH: A/DOUGLAS, R. D. CORP: Defense Technical Information Center, Alexandria, Va.

ABS: This paper is about developing a long range plan for the Defense Technical Information Center (DTIC). That plan, DTIC 2000 - A Corporate Plan for the Future, was published in July 1984. This paper highlights the methodology used to develop the plan. It also outlines an anticipated future information environment in which the Center will operate. Additionally, it displays the long range Scientific and Technical Information Program (STIP) goals which were developed for DTIC in the planning process. Before developing the plan, the group researched many planning and management reference sources. Two of these were particularly helpful in determining the planning methodology used to develop DTIC 2000. One key reference was written by Peter Drucker (Management: Tasks, Responsibilities, Practices), a recognized authority in the field of planning and management. The other key reference was from an unexpected source and author A Christmas Carol by Charles Dickens. Drucker's advice to long range planners closely parallels insights presented by Dickens in his Christmas story.

RPT#: AD-A165640 85/00/00 86N28779

UTTL: Information systems for library databases organized A/ETVERK, T. CORP: Joint Publications Research Service, Arlington, Va. In its USSR Report: Cybernetics, Computers and Automation Technology (JPRS-UCC-86-004) p 27-30 (SEE N86-28694 19-70)

ABS: One of the important resources for speeding up progress in science and technology is the Automated Remote Inquiry System of Scientific Information (TAKS), which is described. In the Soviet Union, an Automated System of the State Science and Technology Information (VINTI) is being established which comprises a system of large information centers. The effective use of the bibliographical retrospective data bases is discussed. 86/04/25 86N28697

UTTL: The library system of the DFVLR: Present status, planned reorganization, user possibilities

AUTH: A/STERNEMANN, P. CORP: National Aeronautics and Space Administration, Washington, D.C. Transl. by Scientific Translation Service, Santa Barbara, Calif.

ABS: This paper gives an overview of the present status, planned alterations, and the scope of users of the DFVLR library, as well as a survey of library related activities outside of the library department. Attention is given to the tasks of the DFVLR which include research, assistance in planning and carrying out projects, and the construction and operation of large test installations, showing how they relate to demands on the library.

RPT#: NASA-TM-77674 NAS 1.15:77674 DGLR-79-084 85/10/00 86N26246

UTTL: Functional managers guide to information systems development

AUTH: A/SHANER, W. B. CORP: Naval Postgraduate School, Monterey, Calif.

ABS: The development of large integrated information systems has had a spotty success record. This thesis investigates the role of the user-management team in the development of these systems and what principal problems the organization must face. The study recommends that the user is the individual with ultimate responsibility for the development of the system. Further the problems that must be faced, in descending order of importance, are: (1) the organization power structure, (2) the people in the organization and (3) the technical issues of data processing.

RPT#: AD-A162367 85/09/00 86N24569

UTTL: Space station data system analysis/architecture study. Task 1: Functional requirements definition, DR-1. Appendix: Requirements data base CORP: McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

ABS: Appendix A contains data that characterize the system

functions in sufficient depth as to determine the requirements for the Space Station Data System (SSDS). This data is in the form of: (1) top down traceability report; (2) bottom up traceability report; (3) requirements data sheets; and (4) cross index of requirements paragraphs of the source documents and the requirements numbers. A data base users guide is included that interested parties can use to access the requirements data base and get up to date information about the functions.

RPT#: NASA-CR-177847 NAS 1.26:177847 MDC-H1343A 85/12/00  
86N20478

UTTL: Space Station data system analysis/architecture study. Task 1: Functional requirements definition, DR-5 CORP: McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

ABS: The initial task in the Space Station Data System (SSDS) Analysis/Architecture Study is the definition of the functional and key performance requirements for the SSDS. The SSDS is the set of hardware and software, both on the ground and in space, that provides the basic data management services for Space Station customers and systems. The primary purpose of the requirements development activity was to provide a coordinated, documented requirements set as a basis for the system definition of the SSDS and for other subsequent study activities. These requirements should also prove useful to other Space Station activities in that they provide an indication of the scope of the information services and systems that will be needed in the Space Station program. The major results of the requirements development task are as follows: (1) identification of a conceptual topology and architecture for the end-to-end Space Station Information Systems (SSIS); (2) development of a complete set of functional requirements and design drivers for the SSIS; (3) development of functional requirements and key performance requirements for the Space Station Data System (SSDS); and (4) definition of an operating concept for the SSIS. The operating concept was developed both from a Space Station payload customer and operator perspective in order to allow a requirements practicality assessment.

RPT#: NASA-CR-177838 NAS 1.26:177838 MDC-H1343A-REV 85/12/00  
86N20473

UTTL: Microcomputer-based local automation model: Functional description

AUTH: A/HARTT, R. W.; B/DONNOR, D. J. CORP: Logistics Management Inst., Bethesda, Md.

ABS: The Microcomputer-based Local Automated Model (MicroLAM) project will demonstrate the integration of a local collection management system with access to remote bibliographic data bases. Through an intelligent gateway processor, users of the system will be able to access a local catalog and the Defense Technical Information Center (DTIC) Technical Reports (TR) data base simultaneously.

The system will consist of a commercial software package (for local collection management) integrated with a subset of the Lawrence Livermore National Laboratory (LLNL) Technology Information System (an intelligent gateway). The intelligent gateway permits sharing of bibliographic resources between the network of technical libraries and information centers within the Department of Defense (DoD) and the DoD technical information clearinghouse -- DTIC. Contained in this functional description are summary description, detailed characteristics and operating environment of the system, as well as the cost factors and development schedule of the LAM project.

RPT#: AD-A160610 LMI-DL503 85/10/00 86N19002

UTTL: Managing computer systems development: Understanding the human and technological imperatives

AUTH: A/CURTIS, G. S. CORP: Naval Postgraduate School, Monterey, Calif.

ABS: This thesis examines the human and technological issues that are often encountered during the development of modern computer information systems. People and technical constraints, including suggestions for minimizing negative consequences, are illustrated throughout the development life cycle. Special emphasis is placed on strategic planning, and user involvement in the requirements definition phase, and user-oriented software. The research consists of a review of current literature concerning techniques, methods and methodologies that are the basis for managing computer information system development. It is a collection of bits and pieces of wisdom by experts from all disciplines within the computer and managing fields. These techniques can be tailored to various scale projects having myriad objectives. The theory and practice of management methods included in this paper can be applied universally to computer projects. However, the study is directed at all U.S. Navy managers who are, or will be, involved in the transition to modern computer information systems.

RPT#: AD-A158976 85/06/00 86N15917

UTTL: Information systems plan CORP: Corps of Engineers, St. Paul, Minn.

ABS: The purpose of this study is to analyze what information the St. Paul District uses, who needs to share data, what are the costs of information management, and who should be responsible for information management. This pilot project authorizes the District to demonstrate the feasibility of automated approaches through the acquisition and use of high technology equipment.

RPT#: AD-A157911 85/04/00 86N13227

UTTL: Towards a global MAP data base

AUTH: A/HARTMANN, G. K. CORP: Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany). In International Council of Scientific Unions Middle Atmosphere Program. Handbook for MAP, Vol. 17 p 26-35 (SEE N86-12837 03-46)

ABS: Sponsored in part by the Deutsche Forschungsgemeinschaft, a global data base of measured data from the Earth's atmosphere, similar but complementary to the data of the meteorological service. Right now there is a large gap between these needs and the available financial means. If this prevails, it might be prohibitive for the generation of such a data base. There must be a compromise between the needs and the means. Priorities must be set. Thus, discussions should be started on which data can be or should be stored. Newly generated data for storage in such a data base is recommended to be handled by the World Data Centers (WDCs). This brief report should help to stimulate discussions and subsequent actions. 85/08/00 86N12838

UTTL: A systems development life cycle study of the information center

AUTH: A/LECHLEITNER, M. L. CORP: Naval Postgraduate School, Monterey, Calif.

ABS: End user computing has penetrated most large organizations in an uncontrolled fashion. The newness of the technology, the lack of management expertise, and the inability to gain corporatewide control under the traditional organizational structure have often resulted in inefficiency, incompatibility, and missed opportunities. One solution to this situation is the Information Center (IC). ICs are centralized coordination centers for end user computing and offer user computer expertise. ICs may be any combination of consulting services, training services, mainframe computer terminals, or microcomputers. This thesis examines the IC concept from the viewpoint of the manager tasked with implementation and provides a methodology, the Systems Development Life Cycle, to evaluate and implement an IC. Each phase of the methodology is explained and some innovative ideas on IC implementation and operation are provided. Examples of past successes and mistakes are also presented.

RPT#: AD-A156977 AD-E950724 85/03/00 86N11079

UTTL: The flow of scientific and technical information in the US Army Research Laboratories

AUTH: A/BIXBY, R. L. CORP: Defense Technical Information Center, Alexandria, Va.

ABS: The Defense Technical Information Center (DTIC) provides information services to the Army, Navy, Air Force, other Department of Defense (DOD) agencies, other Government agencies, and Government contractors. In order to provide this information, DTIC needs to anticipate the flow of needs of its users. An understanding of the flow of scientific and technical information (STINFO) within DTIC user organizations is necessary to provide the best STINFO. This paper was undertaken to trace the flow of STINFO within the Department of the Army's research laboratories and to determine how the Army researcher gathers information. Recommendations are made as to how DTIC can better serve the information needs of the Army.

RPT#: AD-A15050 DTIC/TR-85/4 85/05/00 85N33043

UTTL: The development of information systems at NLR CORP: National Aerospace Lab., Amsterdam (Netherlands). Sponsored by Netherlands Agency for Aerospace Programs A formalized approach to the development of information systems to avoid technical and organizational problems is given. A feasibility study is carried out. In the preliminary system a choice has to be made of several possible systems. The functional system consists of the structured users' requirements. From the functional system, the technical system is derived; first a concept is made, then the elements are designed in detail, and translated into instructions on how to make programs, equipment, and structures.

RPT#: B9580079 83/00/00 85N28884

UTTL: Efforts at office automation and information systems utilization at Martin Marietta Energy Systems, Incorporated

AUTH: A/REEVES, C. A., JR. CORP: Oak Ridge Y-12 Plant, Tenn. ABS: A brief history is given of the efforts at utilization of mainframe computers, personal or desktop computers, standalone word processors, and other such devices at Martin Marietta Energy Systems in Oak Ridge, Tennessee. This discussion is concentrated on how these systems have been used in the office, both for purely technical and management oriented applications. Some detail is also given on how these systems have been used to solve some typical problems in offices, so that others might benefit from lessons learned.

RPT#: DE85-008154 Y/DL-914 CONF-8503118-1 85/03/01 85N28633

UTTL: Design of an interface to an information retrieval network

AUTH: A/MENDOZA, J. D. CORP: Illinois Univ., Urbana-Champaign. ABS: The use of computers for information retrieval has brought about a growth of databases (bibliographic, in particular) as well as an increase in the number of search service centers (SSCs) that make the databases accessible online. This thesis proposes an interface to these SSCs and databases to make the variabilities transparent to the user - an Automatic IRC. The Automatic IRC, aimed to be a full-service information center, provides the following services for the user: (1) assistance in the formation of the query; (2) assistance in the choice of relevant databases and location of SSC(s) that make the database(s) accessible at a low cost; (3) automatic dial-up and log-on to the SSCs and the databases; (4) translation by the SSC query into a format that can be processed by the SSC retrieval system; (5) post-processing of bibliographic citations from online searches (i.e., sorting, merging, eliminating duplicate citations and finishing the output); and (6) location, ordering and delivery of documents.

84/00/00 85N27750

UTTL: Management considerations for an information center  
A/AUVIL, J. D. CORP: Naval Postgraduate School,  
Monterey, Calif.

ABS: Recent studies have shown that the data processing  
industry has a very severe problem to solve. In the next  
few years there is going to be an extensive increase in  
millions of instructions per second available due to  
increases in hardware technology. It is imperative that  
the software development industry find ways to utilize  
this capability. Increased programmer productivity is the  
key. This thesis introduces the Information Center concept  
that will allow management to better utilize existing data  
processing capability by providing users the tools  
required for increased software productivity. An actual  
government installation is used as an example of using a  
modern Systems Analysis approach in the installation of an  
Information Center. Industry trends are discussed and the  
debate of centralization versus decentralization  
presented.

RPT#: AD-A151774 84/09/00 85N27742

UTTL: Research needs on the interaction between  
information systems and their users: Report of a workshop  
CORP: National Academy of Sciences - National Research  
Council, Washington, D. C.

ABS: Workshop participants were requested to define the  
characteristics of information systems that distinguish  
them in terms of purpose, function, and structure; to  
estimate the trends of future technological developments;  
to define the significant behavioral and cognitive issues  
involved; and to formulate recommendations and  
justification for basic research most necessary to improve  
user/information system interaction. The recommendations  
are general in nature and not tied to specific information  
systems. They cover theory/orientation, the acquisition and  
of information, input-output bandwidth, user training and  
support, cognitive effects of programming, information  
technology and jobs, and attitudes and accommodation.

RPT#: PB85-121523 84/10/00 85N19891

UTTL: Evaluation of the National Library of Medicine's  
program in the medical behavior sciences. An analysis of  
the National Library of Medicine's (NLM) handling of  
Medical Behavioral Sciences (MBS) literatures: Some  
research tests of methods for evaluating bibliographic  
databases, executive summary

AUTH: A/GRIFFITH, B. C.; B/WHITE, H. D.; C/DROTT, M. C.;  
D/SAVE, J. D. CORP: Drexel Univ., Philadelphia, Pa.

ABS: The overall purpose of NLM 82-302 is to assess the  
adequacy of National Medical Library (NLM) programs in  
medical behavioral science and ancillary fields. This  
study focuses on assessing bibliographic services in order  
to provide a systematic approach to bibliographic service  
evaluation that can be used in the future as a routine  
method for regular review of NLM performance in this area.  
The project is a comparative evaluation of the adequacy of

the online bibliographic search services of the Library.  
It compares the performance of MEDLARS with that of  
alternative databases and search systems. Findings are  
expected to lead to better informed policy decisions  
regarding literature coverage, indexing practices, and  
changes in the controlled vocabulary.

RPT#: PB84-230481 NLM-82/302/ES 84/01/00 85N12802

UTTL: Evaluation of the National Library of Medicine's  
programs in the medical behavior sciences. Coverage,  
overlaps and gaps in bibliographic databases dealing with  
the Medical Behavioral Sciences (MBS) literature, study 1  
A/STEELE, D. T.; JR.; B/GRIFFITH, B. C.; C/DOWAN, J. A.;  
D/DROTT, M. C.; E/SELINGER, N. E. CORP: Drexel Univ.,  
Philadelphia, Pa.

ABS: The present study was one of two studies designed to  
gather data on MEDLARS performance in selecting the  
medical behavioral sciences (MBS) literature for indexing  
and, indirectly, for general accessibility to the medical  
and auxiliary professions. The overall rationale of both  
studies was to test coverage of large samples of relevant  
literature which, while broadly representative of the  
major MBS fields, oversampled smaller disciplines. The  
present study generated the sample and considers the  
coverage of documents identified as serials.

RPT#: PB84-230499 NLM-82/302/1 83/11/00 85N12801

UTTL: Evaluation of the National Library of Medicine's  
programs in the medical behavior sciences. Test  
retrievals in five major databases covering the Medical  
Behavioral Sciences (MBS) literature, study 2

AUTH: A/MCCLEIN, K. W.; B/WHITE, H. D.; C/GRIFFITH, B. C.;  
D/HORWITZ, S. B.; E/SELINGER, N. E. CORP: Drexel Univ.,  
Philadelphia, Pa.

ABS: The present study tests MEDLINE's ability to deliver  
useful citations in response to queries in the medical  
behavior sciences (MBS). Like other project studies, it  
examines MEDLINE performance in the context of the  
performance of other major databases. Although the study  
analyzes several facets of MEDLINE performance, it also  
calls on the results of other project studies.

RPT#: PB84-230507 NLM-82/302/2 84/01/00 85N12800

UTTL: An investigation of the use, cost, perceived value  
and social context of telecommunications tools in two-year  
college libraries in the southeastern United States  
A/LEE, H. E. CORP: Florida State Univ., Tallahassee.  
ABS: A descriptive study of the use, cost, perceived value and  
social context of telecommunications tools in two year  
libraries in the Southeast was undertaken. There were  
three purposes in the study: (1) to describe the cost and  
use of telecommunications tools; (2) to investigate the  
perceived value of these tools; (3) to investigate the  
social context of the use or non-use of these tools. It  
was found that few libraries in the Southeast employ  
telecommunications tools at a high level. There is little

money available for such tools and costs are relatively high. When telecommunications tools are employed they receive extensive usage by relatively few students. The technology most in evidence is that pertaining to video machines of various types. Computer technology was decidedly under represented, although it was often preferred above other tools. The perception of such tools was positive among librarians, although costs were often perceived as a hindrance to the use of the tools.

84/00/00 85N11901

REPORT DOCUMENTATION PAGE			
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<p>AGARD Lecture Series No.160 Advisory Group for Aerospace Research and Development, NATO <b>EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES</b> Published September 1988 96 pages</p> <p>This Lecture Series presents the current state-of-the-art of evaluating information centers and services both from a theoretical and practical perspective. Case studies are used to demonstrate successful evaluation projects from different countries and to focus on specific evaluation methods and measures. In addition to providing a thorough basis for determining the most appropriate evaluation methods and measures for a given situation and</p> <p>P.T.O</p>	<p>AGARD-LS-160</p> <p>Information centers Evaluation Effectiveness</p>	<p>AGARD Lecture Series No.160 Advisory Group for Aerospace Research and Development, NATO <b>EVALUATING THE EFFECTIVENESS OF INFORMATION CENTRES AND SERVICES</b> Published September 1988 96 pages</p> <p>This Lecture Series presents the current state-of-the-art of evaluating information centers and services both from a theoretical and practical perspective. Case studies are used to demonstrate successful evaluation projects from different countries and to focus on specific evaluation methods and measures. In addition to providing a thorough basis for determining the most appropriate evaluation methods and measures for a given situation and</p> <p>P.T.O</p>	<p>AGARD-LS-160</p> <p>Information centers Evaluation Effectiveness</p>
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